

Bluehead Chub, *Nocomis leptocephalus* (Girard 1856), the First Species of Freshwater Fish Scientifically Described from North Carolina

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Abstract

The Bluehead Chub, *Nocomis leptocephalus*, was the first species of freshwater fish to be scientifically described from North Carolina based upon five specimens collected in the mid-1850s from near the Town of Salem by women from Salem Academy and Salem College. The type locality is suspected to be Salem Creek, a stream in close proximity to the school. To this day, the widespread species continues to inhabit the creek, which is also inhabited by several non-indigenous species. Its persistence in urban streams such as Salem Creek may be due to its adaptability to build nests of clean gravel that also benefit its nest associates. Of the 36 species described from North Carolina, 20 of them are extant and 16 are extirpated from their type locality. Species that have persisted are either adaptable species, are found in relatively undisturbed habitats and forested watersheds, or are found where there have been no drastic changes in their watershed. Species were extirpated from their type locality because of habitat fragmentation by dams, persistent water quality impairment and fish kills, possible competition and predation by non-indigenous species, landscape changes, or for reasons yet known.

Introduction

In 2008, I began investigating the history of North Carolina's freshwater fish type localities, including those 15 species described by Edward Drinker Cope. The type locality is the place where the population occurs from which the type specimen (the "name bearer" for the species) was taken (Mayr 1969). The first five of the 205 or so currently described and indigenous freshwater fish species known from North Carolina were scientifically named in 1758 by Carolus Linnaeus (Linnaeus 1758), though generally from locales in Europe, the northern United States or the "Carolinas" (i.e., Sea Lamprey, *Petromyzon marinus*, Longnose Gar, *Lepisosteus osseus*, Bowfin, *Amia calva*, White Catfish, *Ameiurus catus*, Redbreast Sunfish, *Lepomis auritus*, and Pumpkinseed, *Lepomis gibbosus*) (Lee et al. 1980). A flurry of activity in the late 1810s by Constantine Rafinesque ascribed names for 25 more nominal species, again from locales outside the state. But it was not until 1856 when the first species of freshwater fish was described from North Carolina. The species was a minnow in the Family Cyprinidae, the Bluehead Chub, *Ceraticthys leptocephalus*, named by Charles F. Girard, the first ichthyologist at the Smithsonian Institution (<http://>

vertebrates.si.edu/fishes/ichthyology_history/ichs_colls/girard_charles.html).

Since the initial description of the Bluehead Chub, 35 other presently recognized species were named from North Carolina (Tracy 2010, Tracy 2012). I became interested in determining if each species was still extant at its type locality and what the current environmental conditions of the type locality and surrounding landscape were like. Between December 2008 and November 2010, I visited and surveyed each locality. The purpose of this paper is to describe the history behind my discovery of the type locality of the Bluehead Chub and what conditions were like when I surveyed the site in July 2009.

Materials and Methods

Type localities were determined by seeking out the original species description in the scientific literature and by on-line electronic database queries of museums curating the type specimens. These museums included the Academy of Natural Sciences of Philadelphia (now known as the Academy of Natural Sciences of Drexel University, <http://www.ansp.org/>), the National Museum of Natural History (also known as the Smithsonian Institution, <http://vertebrates.si.edu/fishes/>), University of Michigan Museum of Zoology (<http://www.lsa.umich.edu/ummz/>), and the Royal D. Suttkus Fish Collection at Tulane University (<http://www.tubri.org/fishes/>). Using the site description provided by the author and by examining 7.5 minute USGS topographic maps, I was able to find the precise locality or a general locality for each species. I surveyed each site with a backpack electrofisher and dip net, dip net, or seine; measured routine water quality variables (temperature, dissolved oxygen, specific conductance, and pH), and made notes on the instream and riparian habitats and of the nearby watershed. Specimens collected were preserved and vouchered at the North Carolina State Museum of Natural Sciences (NCSM) in Raleigh.

Results

Girard's original species description of *Ceratichthys leptocephalus* (later re-named *Nocomis leptocephalus* (Girard) by Hubbs [1926]), was very concise: "A species easily to be distinguished from its congener [referring to *Ceratichthys biguttatus* (= *Nocomis biguttatus*) and *Ceratichthys amblops*

(= *Hybopsis amblops*)], by its small head which enters four times and a half in the total length. The body itself is proportionally shorter than in *C. amblops* especially. Its scales are likewise larger than in the latter species. The color is of uniform blackish grey above, and grayish white beneath" (Girard 1856, page 213). More than likely, the specimens would have been preserved in spirits (alcohol), but for how long, that can not be determined. Noticeably lacking from this description is any mention of how many specimens his description was based upon, the presence of cephalic (on the head) breeding tubercles which certainly would have been noticed if present, or the size of the specimens. Since Girard's 1856 original description, other ichthyologists have written substantially more detailed descriptions, for example in Lachner and Jenkins (1971), Lachner and Wiley (1971), Jenkins and Burkhead (1994), and Rohde et al. (2009).

Currently, there are three recognized and scientifically described subspecies of *Nocomis leptocephalus*: 1) *N. l. leptocephalus* (Girard 1856), 2) *N. l. interocularis* Lachner and Wiley (1971), and 3) *N. l. bellicus* (Girard 1856) (Lachner and Wiley 1971); (Scharpf 2005). The subspecies that Girard encountered from North Carolina would have been *N. l. leptocephalus*. A recent phylogenetic study by Nagle and Simons (2012) proposed that *N. leptocephalus* may actually be five distinct species: 1) *N. sp. cf. leptocephalus* in the New, Roanoke, James, and Neuse River drainages, 2) *N. leptocephalus* in the Pee Dee, Cape Fear, Edisto, and Santee River drainages, 3) *N. interocularis* in the Savannah, Altamaha, and Chattahoochee River drainages, 4) *N. bellicus* in the Mobile River drainage, and 5) *N. sp. cf. bellicus* along the western Gulf Slope west of the Mobile Basin to the Mississippi (Nagle and Simons 2012).

The original genus name "*Ceratichthys*" means "*Cerato*"-horn or horned and "*ichthys*"-fish, or horned fish, in reference to the cephalic breeding tubercles (Brown 1954). Breeding males develop medium- to very-large tubercles and swollen nuptial crests on the head (see cover), prompting local fishermen to call this fish "knotty-head," "horny head," or other colorful and colloquial names (see page 16). The specific epithet "*leptocephalus*" means "small head" (Jenkins and Burkhead 1994). *Nocomis* is an Iroquois Indian name for "daughter of the moon" indicating a feminine derivation from Nokomis in Longfellow's 1855 poem

Song of Hiawatha (Jordan 1929 in Jenkins and Burkhead 1994).

Girard (1856, page 213) goes on to write: “*Specimens were collected at Salem, N. C. by J. Lineback and School, . . .*”. The specimens were collected in the early 1850s (circa 1850-1855, precise date unknown) by J. T. Lineback (correctly spelled Linebach), one of the founding families of the Moravian community of Salem in Forsyth County (Dr. Carol Dykers, Salem College, personal communication, October 29, 2008). Linebach, who turns out was a man, was assisted by students from Salem Academy, a women’s school in Salem which opened in 1772 (<http://www.salemacademy.com/>) and from Salem College, the oldest women’s college in the nation. Remarkable is the fact that the specimens were collected in the early 1850s by women, during a time when few women in the South were afforded a formal education. They attended a school that believed women deserved an education comparable to that given men—a radical view for that era (<http://www.salem.edu/about/our-history>).

Historically, when a species was first described the author often did not specify a type locality. The Bluehead Chub type locality was not precisely specified by Girard, however, Lachner and Wiley (1971) were slightly more specific in listing the type locality as: “*Salem, North Carolina, probably Winston-Salem, from a tributary of Yadkin River; Pee Dee River drainage.*” After communicating with Dr. Dykers, reviewing the literature cited previously, examining the image from the Smithsonian’s ledger, and consulting a USGS topographic map, I concluded that the only small Wadeable stream which would likely have

contained Bluehead Chub near the historic Town of Salem and within walking distance, literally “down the hill” from Salem Academy and Salem College near the South Main Street bridge, would have been Salem Creek near latitude 36.08109 N and longitude -80.24046 W (Figure 1). This must have been the type locality where J. T. Lineback and students collected the first specimens of Bluehead Chub in the early 1850s.

Girard (1856, page 213) continues: “. . . and preserved in the Museum of the Smithsonian Institution.” In February 2013, I went back online to the Smithsonian Institution’s webpage and once more queried their electronic database (<http://collections.mnh.si.edu/search/fishes/>). I discovered there were five original specimens or syntypes under Catalogue Number USNM 12 (<http://collections.mnh.si.edu/vzfishes/pages/nmnh/vz/displayfishes.php?irn=5135814&querypage=%2fvzfishes%2fpages%2fmnh%2fvz%2fdtqueryfishes.php>). Syntypes are every specimen in a type series in which no holotype (the name bearer) was designated (Mayr 1969). Prepared on December 17, 1856, they represented the 12th lot of specimens ever catalogued at the Smithsonian Institution (Figure 2, Line 12). The pharyngeal arches may have been originally catalogued earlier in the osteological collection and assigned the Catalogue Number 2633 (Gilbert 1998). Unfortunately, the five specimens are no longer extant (Gilbert 1998; <http://research.calacademy.org/ichthyology/catalog>). Apparently, the specimens were recorded lost in 1995 (personal communication, Dr. Lisa Palmer, Smithsonian Institution, February 20, 2013). Dr. Jeff Williams, also with the Smithsonian Institution, provided me with a little bit more information. If you look closely at the

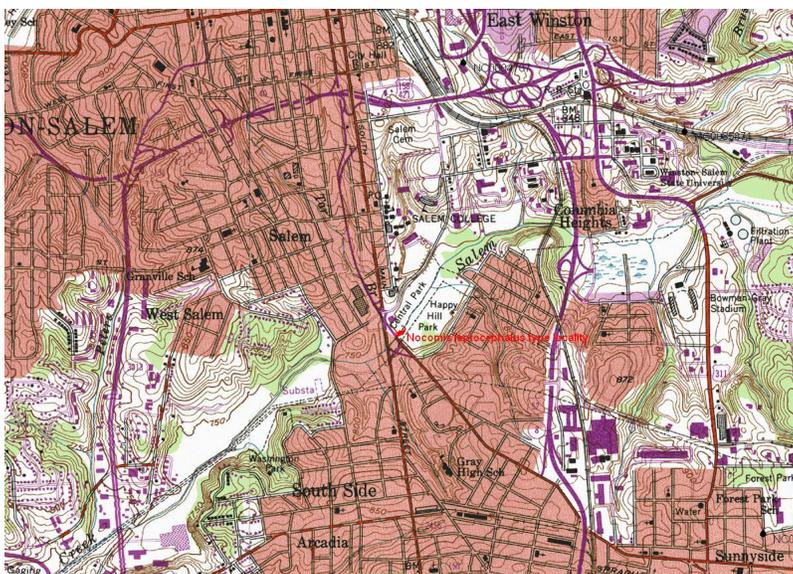


Figure 1. Suspected type locality of the Bluehead Chub, *Nocomis leptocephalus*, Salem Creek, Forsyth County, North Carolina. The red wording indicates the type locality.

Date	Number	Name	Locality	Sex	Measurements	Collector	Prepared by	Date	No. of specimens	Remarks	Notes
	1	Ceratichthys leptocephalus	Salem, N.C.	Males	1183	J.T. Lineback	Sch.	Dec 17 1856	5		
	2	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	3	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	4	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	3		
	5	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	6	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	7	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	8	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	9	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	10	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	11	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	12	Ceratichthys leptocephalus	Salem, N.C.	Males	1183	J.T. Lineback	Sch.	Dec 17 1856	5	Pharyngeal bones, no- (undecipherable letters) skeletons	2633
	13	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	14	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	15	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	16	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	17	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	18	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	19	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	20	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	21	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	22	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	23	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		
	24	Aphogaster maculatus	Salem, N.C.		1183	J.T. Lineback	Sch.	Dec 17 1856	1		

Figure 2. Image of the original ledger from the United States National Museum showing the 12th entry ever recorded at the museum which was *Ceratichthys leptocephalus* Girard, type specimen, Forsyth County, Salem, N.C. J.T. Lineback & Sch, prepared on December 17, 1856, 5 specimens. The black arrow points to the entry.

upper right corner of Figure 2 under the column heading “Remarks” and with an arrow pointing from “Note,” you can read: “Pharyngeal bones, no- (undecipherable letters) skeletons” and further down the column at line 12 is the number-2633. According to Dr. Williams: “Only the pharyngeal bones were retained from that series of catalog numbers (USNM 1-21) and all of them were types. The heads and bodies of that first series of cataloged specimens were not preserved. Evidently those small bones from USNM 12 were lost at some point. We still have the pharyngeal bones from the adjacent catalog numbers” (personal communication, February 20, 2013).

The Type Locality Today

As of July 10, 2009, the Bluehead Chub was still inhabiting Salem Creek, where they were found in the swift riffles and runs, upstream and downstream from the pedestrian bridge (Figure 4). Thirteen specimens were vouchered at NCSM, five specimens in 70% ethanol and eight specimens in 95% ethanol (NCSM Catalogue No. 59202). Unfortunately, the stream is now an urban stream with elevated specific

conductance (107 $\mu\text{S}/\text{cm}$) indicative of nonpoint pollutant runoff, turbid, and littered with tires and bricks. Typical of countless such streams, Salem Creek is now hydrologically flashy. Its banks are over-grown with Japanese Knotweed (*Fallopia japonica*) and the streams flows beneath a graffiti-defaced bridge. Today, the 44 square mile Salem Creek watershed is vastly different than the one of the mid-1850s. In 2006, 3% was in grassland/herbaceous cover, 8% was in cultivation, 25% was forested, and 61% was developed (urbanized). Almost 14% of its watershed was covered by impervious surfaces (http://water.usgs.gov/osw/streamstats/north_carolina.html).

On that day in July 2009, fish indigenous to and common in tributaries of the middle Yadkin River system such as the catostomids Brassy Jumprock, *Moxostoma* sp., and Notchlip Redhorse, *Moxostoma collapsum*, were absent as were Tessellated Darter, *Etheostoma olmstedi*, and Carolina Fantail Darter, *Etheostoma brevispinum*. Nonindigenous fish species syntopic with the Bluehead Chub at this site were the tolerant Red Shiner, *Cyprinella lutrensis*, the nest associate Rosefin Shiner, *Lythrurus ardens*, and the piscivorous Flathead Catfish, *Pylodictis olivaris* (including one specimen about 850 mm total length). Only two indigenous species were collected along with Bluehead Chub—the tolerant Redbreast Sunfish, *Lepomis auritus*, and Largemouth Bass, *Micropterus salmoides*.



Figure 3. Salem Creek, looking upstream from the South Main Street bridge, City of Winston-Salem, Forsyth County. Bluehead Chub were collected in the riffle in July 2009. Bryn Tracey

Distribution in North Carolina

The Bluehead Chub is one of the most widely distributed and abundant species of indigenous freshwater fishes in North Carolina. Its historical distribution ranges from the Savannah River drainage in the southwest corner to just east of the Fall Line in the Tar River drainage (Menhinick 1991; Figure 4). It has been introduced, probably through bait buckets, into tributaries of the upper Toe River (Mitchell County) and Cane River (Yancey County) in the Nolichucky River system, in Mud Creek (Henderson County) in the upper French Broad River system, and in tributaries to the upper Cullasaja River (Macon County) in the upper Little Tennessee River system (NCDWQ and NCSM databases). It is typically found throughout the Piedmont and the Eastern Blue Ridge Foot Hills in headwater streams, creeks, and small rivers. It occupies pools, runs, and swift riffles with highly varied substrates from bedrock to much sand and silt, but with at least moderate sized areas of gravel (Jenkins and Lachner 1980). The lack of gravel in Coastal Plain streams is believed to be one of the reasons for its absence in the eastern part of North Carolina. Outside of North Carolina, *N. leptocephalus*, in the broadest sense, ranges from the Potomac River drainage south on the Atlantic slope to Georgia, and west on the Gulf slope to the lower Mississippi River tributaries in Louisiana and Mississippi; in the Ohio River basin it is moderately widespread in the New River drainage (Jenkins and Burkhead 1994).

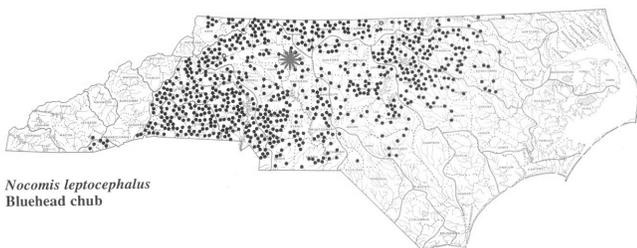


Figure 4. Distribution of the Bluehead Chub, *Nocomis leptocephalus*, in North Carolina as of 1991 (Menhinick 1991). Star symbol shows the location from which the Bluehead Chub was originally collected in 1856.

This stout-bodied minnow may approach 275 mm in total length; longevity is up to five years. The diet of the Bluehead Chub includes plant material, particularly algae, and aquatic insects. Streams that receive too much nutrients from runoff often have large populations of Bluehead Chubs. However, the Bluehead Chub is a “keystone” species in our Piedmont and Eastern Foothill streams. During the spring, dominant large males construct and defend gravel-mound nests over which males and females spawn and which are also used by nest associates—other species of daces and shiners, such as the Mountain Redbelly Dace and Greenhead Shiner. The nest is carefully constructed stone-by-stone with some nests approaching 100 cm in diameter, 30 cm in height, and built in as little as a day (Peoples 2012). The defending males keep the gravel clean, thus enhancing the survival of eggs and larvae of all the species. By building nests, Bluehead Chubs create patches of clean gravel that nest associates require for spawning (Peoples 2012). Streams that have suffered from nonpoint source sedimentation, covering the gravel required for nest building, tend to have fewer Bluehead Chub and overall lower fish diversity than streams with a clean gravel substrate. Peoples et al. (2012) provided evidence that the nesting activity by male Bluehead Chub may be a mechanism by which the species is able to persist in degraded streams such as Salem Creek.

Discussion

It is believed that the Bluehead Chub is the first vertebrate species to be scientifically described from North Carolina. Several vertebrate species described before 1856, such as Pumpkinseed (*Lepomis gibbosus*), Carolina Parakeet (*Conuropsis carolinensis*), Eastern Gray Squirrel (*Sciurus carolinensis*), Carolina Anole (*Anolis carolinensis*), and the Eastern Box Turtle (*Terrapene carolina*), were described from material collected from the colony of “Carolina,” but was often the case, they were collected in the vicinity of Charleston, South Carolina.

Of the 36 species described from North Carolina, 20 of them are extant and 16 are extirpated from their type locality, although they continue to be found in the state (Tracy 2012). Species that have persisted are either adaptable species (such as the Bluehead Chub), are found in relatively undisturbed habitats and forested watersheds (e.g., Carolina Pygmy Sunfish, *Elassoma boehlkei*), or are found where there have been no dras-

tic changes in their watershed (Whitemouth Shiner, *Notropis alborus*). Species were extirpated from their type locality because of hydrological modifications and habitat fragmentation by dams (e.g., Pinewoods Darter, *Etheostoma mariae*), persistent water quality impairment (Dusky Shiner, *Notropis cummingsae*), chemical spills and resultant catastrophic fish kills (e.g., Cape Fear Shiner, *Notropis mekistocholas*), possible competition and predation by non-indigenous species (e.g., Highback Chub, *Hybopsis hypsinotus*), landscape changes including urbanization (e.g., Glassy Darter, *Etheostoma vitreum*), or for reasons yet known (e.g., Wounded Darter, *Etheostoma vulneratum*).

On December 14, 2009, I petitioned North Carolina's Department of Cultural Resources' Office of Archives and History, Division of Historical Resources/ Research Branch (<http://www.ncmarkers.com/Home.aspxlink>) to have a historical marker placed approximately 275 ft. northwest (latitude 36.0812761 North and longitude -80.2401107 West) of the type locality of the Bluehead Chub. The marker was to have read: "Bluehead Chub (*Nocomis leptocephalus*), first species of freshwater fish scientifically described from North Carolina by Charles F. Girard, 1856." The petition included much of the material that I have presented in this essay. Six months later on June 04, 2010, I received a reply—my petition was not approved. Apparently, even with a committee member a specialist in environmental history, the members (all with PhDs) found that this milestone in natural history fell outside the purview of identifying subjects of strictly statewide historical significance. I guess the historical ties with Salem Academy, Salem College, and the Smithsonian Institution, most likely the first vertebrate ever described from the state, and one of the state's most common freshwater fish, collectively were not of historical value. Ichthyologists would beg to differ.

Acknowledgments

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Images by N. Burkhead and R. Jenkins, courtesy of Virginia Department of Game and Inland Fisheries. Male Bluehead Chub above, female below.



Male Bluehead Chub with close-up of head and tubercles Mayo River, North Carolina. Images courtesy of Dustin Smith