

THE DISTRIBUTIONAL STATUS OF SEVEN NONINDIGENOUS SPECIES IN THE YADKIN-PEE DEE RIVER DRAINAGE IN NORTH CAROLINA



Bryn H. Tracy

North Carolina Division of Water Resources (Retired)

For more than 21 years, I documented the occurrences and distributions of the indigenous and nonindigenous freshwater species throughout the state as project leader of the North Carolina Division of Water Resources (DWR) Wadeable Stream Fish Community Assessment Program. Most of my work was with the basinwide assessment program, which evaluates a core group of long-term monitoring sites on a five-year rotating cycle. The Yadkin-Pee River drainage was the first basin I sampled in 1996 and I sampled it every five years through 2016 for a total of five cycles. During this time, I became interested in trying to figure out what was indigenous and what was nonindigenous through historical and forensic ichthyology, not just in this drainage, but throughout the state (Tracy et al. 2013). At North Carolina American Fisheries Society chapter meetings since 1997 and in numerous chapter newsletter articles (e.g., Tracy 2008, 2009, Tracy and Schneider 2009), I presented much of what I had learned about our state's ichthyofauna, especially on species encountered in the Yadkin-Pee Dee River drainage.

The Yadkin-Pee Dee River drainage in North Carolina is home to, per my count, 113 species of freshwater fishes, tied with the Roanoke River drainage as being the most speciose (Tracy et al. 2013). A little known fact: the first species of freshwater fish ever described from North Carolina, the Bluehead Chub, *Nocomis leptcephalus* (Girard 1856) was described from this drainage (Tracy 2013). However, 34 spe-

cies are nonindigenous and this is second to the Catawba River drainage in North Carolina. In this article, the focus is on seven nonindigenous cyprinid species—Red Shiner, Warpaint Shiner, Central Stoneroller, Mountain Redbelly Dace, Rosefin Shiner, Swallowtail Shiner, and Comely Shiner—one of which was introduced more than 50 years ago and one as recently as the early 2000s. Each of these seven species is now considered to be “established.” According to Shafland et al. (2008), nonindigenous species are considered established if they “. . . a) can be consistently collected from large or interconnected public waters from which they cannot be practically eliminated, b) are present in sufficient abundance to indicate the population has been stable or expanding for several years, and c) no species-specific environmental limiting factor exists that could reasonably cause their demise (e.g., water temperature, drought).” The distributional patterns and histories of dispersal of several of the 34 nonindigenous species overlap, suggesting similar modes of introductions. The most likely origins of many introductions of indigenous species into extralimital river drainages are through bait bucket releases (Fuller et al. 1999, Jenkins and Burkhead 1994).

Databases queried for this article were those of the DWR, the North Carolina Wildlife Resources Commission, the North Carolina State Museum of Natural Sciences, Global Biodiversity Information Facility, FishNet2, Duke Energy, the Academy of Natural Sciences of Drexel University, Appalachian State University, Tulane University, the Ohio State Museum of Biological Diversity, the Georgia Museum of Natural History, the University of Michigan Museum of Zoology, and the USGS Nonindigenous Aquatic Species. Photographs are reproduced courtesy of Dr. Robert E. Jenkins, Noel Burkhead and Fritz Rohde via the Southeastern Fishes Council website, and

Bryn H. Tracy was the project leader for the Wadeable Stream Fish Community Assessment Program. He had worked in the aquatic sciences field in North Carolina since 1983. His interests in retirement will continue to focus on the ichthyological history and distribution of the state's indigenous freshwater fish fauna and in the introduction, dispersal, and impact of the ever-increasing list of nonindigenous species.

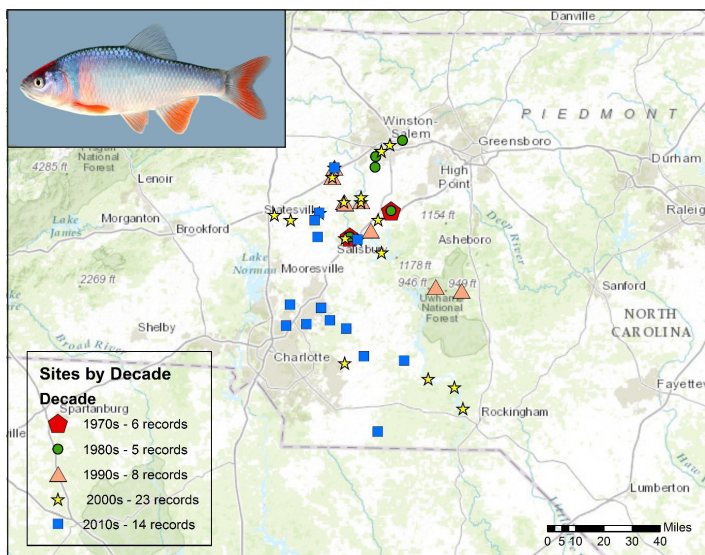


Figure 1. Known distribution of the Red Shiner (*Cyprinella lutrensis*) in the Yadkin-Pee Dee River drainage as of December 31, 2016.

Uland Thomas via the North American Native Fishes Association website.

RED SHINER, *CYPRINELLA LUTRENSIS* (BAIRD & GIRARD, 1853)

The Red Shiner was first discovered in North Carolina in the Yadkin-Pee Dee River drainage in 1974 by Moore et al. (1976) from Abbotts Creek (in the city of Lexington, Davidson County) and from Grants Creek (in the town of Spencer, Rowan County). By 1991, it had spread to an additional seven sites in the drainage (Menhinick 1991). Since Tracy (2007b), the Red Shiner has been found at an additional 16 sites, many of them in the Rocky River subbasin. By the end of 2016, 42 years after its initial discovery, it is now known to occur at more than 40 separate localities spread across 12 Piedmont counties in the drainage (Figure 1). [Note: In North Carolina, the nonindigenous Red Shiner is also found in Stokes, Caswell, and Person counties in the Roanoke River drainage and in Guilford County in the Cape Fear River drainage.]

Free-flowing streams in the Yadkin-Pee Dee River drainage have been fragmented by many dams (Tracy et al. 2013), but the Red Shiner seems to have ignored such barriers. Since 1974, following what likely has been multiple, independent human-assisted introductions and natural dispersal across the drainage, the Red Shiner is now found: in the mainstem of the Pee Dee River below Blewett Falls Reservoir; throughout the Rocky River subbasin, as far upstream as Mallard and Clarke creeks; the Uwharrie River; the Little River; tributaries to the South Yadkin River downstream from the Coolemees Dam, High Rock Lake; the mainstem of the Yadkin River and several of its tributaries as far up-

stream as Davie and Forsyth counties, and the mainstem of the Yadkin River near Ronda (Figure 1). Further dispersal in the South Yadkin River system is prevented by the Coolemees Dam at Coolemees. It was believed that further dispersal upstream in the upper Yadkin River system would have been prevented by Idols Dam (a barrier to fish passage since it was constructed in 1898) and by Northwest Filter Plant Dam (built in 2003). The discovery of a specimen in the Ohio State University Museum of Biological Diversity collected in 2009 at Ronda (more than 50 miles upstream from the Northwest Filter Plant Dam) does not portend good news because the Red Shiner could now theoretically colonize any available tributary as far upstream as Kerr Scott Dam, including the Little Yadkin, Ararat, Fisher, and Mitchell rivers watersheds. Fortunately, Red Shiners were not found by DWR staff in 2016 in any tributaries upstream from Idols Dam.

The Red Shiner is behaviorally aggressive, readily hybridizes with other species of *Cyprinella*, and is tolerant of poor water quality, low flow conditions, low dissolved oxygen concentrations, elevated turbidity, and elevated stream temperatures. It can be abundant in shallow, sandy bottom streams, is commonly used as a bait fish, and was once marketed in the aquarium trade (Fuller et al. 1999, Walters et al. 2007). The Red Shiner has been reported to reproduce within its first summer of life and can have a breeding season lasting at least three months (Herrington and DeVries 2008). Since August 2004, it has been unlawful to transport, purchase, possess, sell, or stock Red Shiners in public or private waters of North Carolina (North Carolina Administrative Code 15a NCAC 10C .0211) because of its negative invasive attributes including, but not limited to: potentially hybridizing with other species of *Cyprinella* such as Fiery-black (*C. pyrrhomelas*), Satinfish (*C. analostana*), and Whitefin (*C. nivea*) shiners, interspecific competition, and species displacement.

The Red Shiner's introduction has been "very successful" because the species has persisted, dispersed, and reproduced throughout its range in the Yadkin-Pee Dee River drainage in North Carolina. Ironically, there are some indications that the potential native source of introductions may have been the Salt River in northeastern Missouri (Glottzbecker et al. 2016) where I worked on a multi-year pre-impoundment study as a graduate student in the mid to late 1970s while at the University of Missouri-Columbia.

WARPAINT SHINER, *LUXILUS* *COCCOGENIS* (COPE, 1868)

The Warpaint Shiner was described from the upper Holston River in Virginia and is indigenous to the middle and upper Tennessee River drainage in Virginia, Tennessee, North Carolina, Georgia, and Alabama, and in the upper Savannah

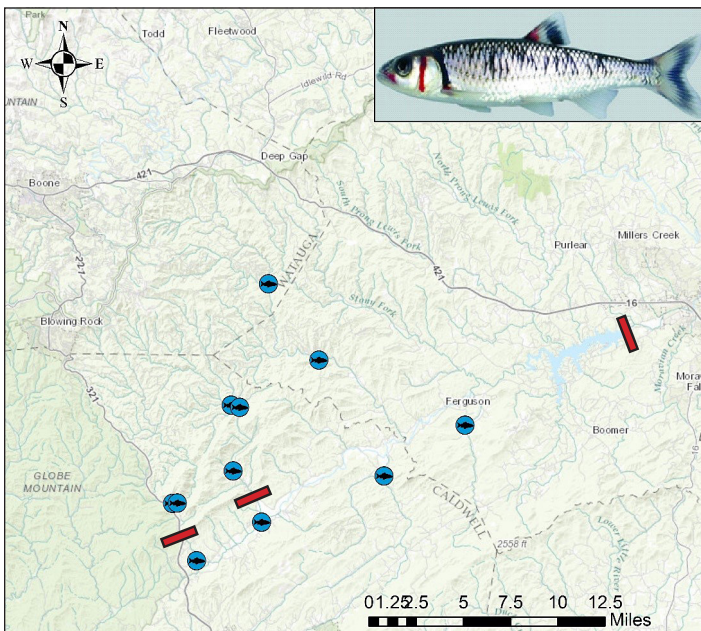


Figure 2. Known distribution of the Warpaint Shiner (*Luxilus coccogenis*) in the upper Yadkin-Pee Dee River drainage as of December 31, 2016. Red bars denote dams.

River drainage in South Carolina (Jenkins and Burkhead 1994; Fuller, et al. 1999). The Warpaint Shiner is commonly found in usually clear, cold to cool water streams inhabiting flowing pools, runs, and along the edges of riffles. It is insectivorous, with a large eye, large, protrusible, obliquely terminal mouth, and sharp-pointed, raptorial pharyngeal teeth, feeding primarily on mayflies and terrestrial insects in the middle of the water column and at the surface (Outten 1957). Evolutionarily, it is an obligate spawning associate of the nest building River Chub (*Nocomis micropogon*). However, since its introduction into other river systems, it has adapted to spawning over the nests of other species of *Nocomis* (i.e., Bigmouth Chub, *N. platyrhynchus*, and Bluehead Chub, *N. leptocephalus*).

The Warpaint Shiner was not known to occur in the Yadkin-Pee Dee River drainage until 1996 when 10 specimens were collected by DWR staff from the Yadkin River at NC 268 in Caldwell County (NCSM Catalogue Number 50121; Tracy 2007b). Since then, Warpaint Shiners have been found in five sub-watersheds at 10 sites, representing 25 collections, all upstream of Kerr Scott Reservoir in Wilkes, Caldwell, and Watauga counties (Figure 2). It was believed that the lot from 1996 represented the first known occurrence of its introduction in the drainage. However, on November 30, 2005, Dr. Wayne C. Starnes re-identified a lot of seven specimens collected eight years earlier at a site just upstream from the 1996 site that had been identified as Telescope Shiner (*Notropis telescopus*, NCSM Catalogue Number 15273). Five of the specimens turned out to be Redlip Shiner (*N. chiliticus*, NCSM Catalogue Number 42739) and two specimens were

re-identified as Warpaint Shiner (NCSM Catalogue Number 15273).

It is thought that Warpaint Shiner was introduced, probably through bait bucket introductions, sometime between 1979 (following surveys in the late 1970s by Mickey [1981]) and 1988. Prior surveys (e.g., Bailey (1949); Tatum et al. (1963); Philips (1980); Mickey (1981); and Bonner (1983a, 1983b)) all failed to detect the species' presence in this drainage. It was also not reported as occurring in the drainage by Gilbert (1964), Ramsey (1965), Gilbert (1980), Hocutt et al. (1986), or Menhinick (1991).

Its expansion gives credence that since its original introduction, it has spread naturally, but there have also been other separate introductions. For example, the Warpaint Shiner is now found above and below Omni Supply Dam near Patterson and above the abandoned Buffalo Creek Dam (36.029722°, -81.513333°) near Ledgerwood. Source populations might have included the Watauga or French Broad River subsystems where the species is indigenous or from the New and Catawba River subsystems where the species is nonindigenous. Genetic studies could shed light on where these introduced populations originated.

Currently, the Warpaint Shiner is found in every watershed upstream from the backwaters of Kerr Scott Reservoir, except that of Stony Fork into which it may eventually disperse. It is presumed to be unable to move further downstream because the Yadkin River near the West Yadkin Trail and Canoe Access area transitions from a lotic to a lentic environment. Warpaint Shiner, being a strictly lotic species and obligate spawning associate of nest building *Nocomis*, would find Kerr Scott Reservoir an inhospitable environment for colonization, inhabitation, and further downstream migrations. If by some chance, the species does survive and colonize all tributaries draining into the reservoir (e.g., Lewis and Warrior forks), further downstream expansion would hopefully be prevented by the presence of the Kerr Scott Dam.

Other nonindigenous species sympatric with the Warpaint Shiner in these streams include Central Stoneroller (*Camptostoma anomalum*), Striped Jumprock (*Scartomyzon rupiscartes*), Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*), Smallmouth Bass (*Micropterus dolomieu*), Rock Bass (*Ambloplites rupestris*), and Redear Sunfish (*Lepomis microlophus*). Other insectivorous cyprinids co-occurring in these streams with whom Warpaint Shiners might compete include Rosyside Dace (*Clinostomus funduloides*), Redlip Shiner, Sandbar Shiner (*N. szepticus*), Fierlyblack Shiner, Satinfish Shiner, Thicklup Chub (*Cyprinella labrosa*), Creek Chub (*Semotilus atromaculatus*), Highback Chub (*Hybopsis hypsinotus*), and Blacknose Dace (*Rhinichthys obtusus*). Interspecific interactions and ecological im-

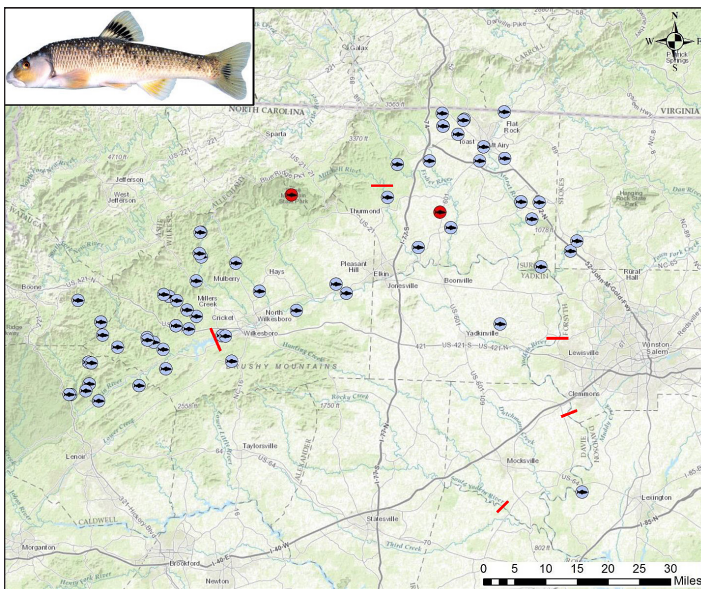


Figure 3. Known distribution of the Central Stoneroller (*Campostoma anomalum*) in the Yadkin-Pee Dee River drainage in North Carolina as of December 31, 2016. Red symbols denote the first known occurrences and red bars denote dams.

pacts to the native fish communities in the upper Yadkin-Pee Dee River drainage from this recent inhabitant are unknown and warrant further study.

CENTRAL STONEROLLER, *CAMPOSTOMA ANOMALUM* (RAFINESQUE, 1820)

The Central Stoneroller inhabits small to medium-sized streams (lotic waters) with clear, cool water, sometimes with rapid current (Burr 1980). Prior to Menhinick et al. (1974), there were no published records (e.g., Cope [1870], Smith [1907], Bailey [1949], or Tatum et al. [1963]) for this species possible occurrence in the Yadkin-Pee Dee River drainage and no records were shown in Burr (1980). The first unpublished discovery was made by Joseph Bailey and Duke University students on August 02, 1960, from Bullhead Creek at SR 1739, Wilkes County, n=1 (Figure 3). Another early collection was made by Robert E. Schmidt on March 13, 1979 from Cody Creek at SR 1104, Surry County, n = unknown. The closest possible source population(s) from which the Central Stoneroller may have originated is/are from the Dan River system (Roanoke River drainage), the New River drainage, the Watauga River system (Holston/Tennessee River drainage), and from the Catawba River system (Santee River drainage). [Note: The species or subspecies designation of the Central Stoneroller in the Yadkin-Pee Dee River drainage is uncertain because specimens from this drainage were not available for the most recent work published on this genus (Blum et al. 2008).] Genetic studies could shed light on where these introduced populations originated.

Between 1960 and 2016, 118 collections exist of Central Stoneroller from the Yadkin-Pee Dee River drainage with the number of specimens represented in each collection ranging from 1 to 184 (the latter from a 600-ft. reach in Laurel Creek at SR 1508 in Watauga County, May 05, 1999). Currently, the species is widely distributed into many of the watersheds in the upper Yadkin River system in Watauga, Caldwell, Wilkes, Surry, and Stokes counties (Figure 3) because of multiple introductions and natural dispersal. It is also found downstream as far as Forbush Creek in Yadkin County and Gobble Creek in Davidson County (Figure 3). However, it has not been collected from the East Prong Roaring River watershed (Bullhead Creek) or from the entire Roaring River watershed since 1960, indicating that this introduction has most likely failed. It is predicted that the Central Stoneroller could colonize and disperse throughout the upper and middle Yadkin River system where dispersal is not limited by dams (e.g., Northwest Filter Plant, Idols, Coolemee, and High Rock dams), reservoirs (High Rock), or poor water quality.

MOUNTAIN REDBELLY DACE, *CHROSOMUS OREAS* (COPE, 1868)

The Mountain Redbelly Dace is a lotic inhabitant of small, cool to warm, clear to often turbid, sandy to rocky streams (Starnes and Starnes 1980). There were no published records (e.g., Bailey [1949] or Tatum et al. [1963]) of the species existence in the Yadkin-Pee Dee River drainage prior to Menhinick et al. (1974). There was a single report in Starnes and Starnes (1980) “. . . from the upper Yadkin system (Pee Dee drainage), North Carolina, probably based on an introduction,” but no localities were shown on their map. The first

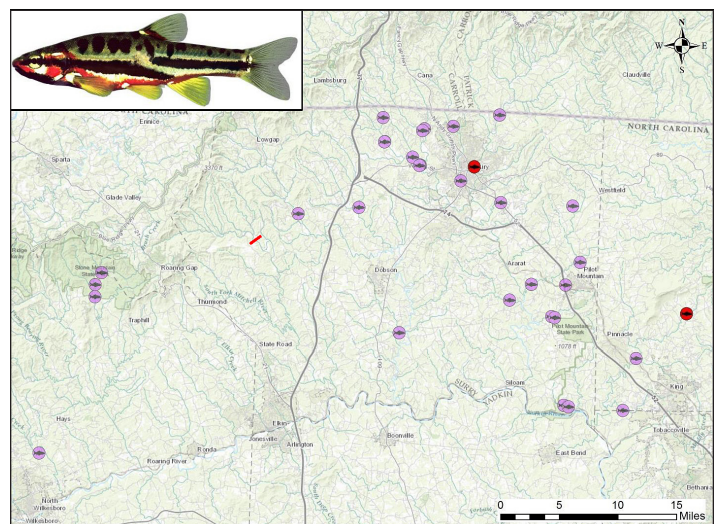


Figure 4. Known distribution of the Mountain Redbelly Dace (*Chrosomus oreas*) in the Yadkin-Pee Dee River drainage in North Carolina as of December 31, 2016. Red symbols denote the first known occurrences and red bar denotes a dam.

discovery and earliest records of the Mountain Redbelly Dace was from an unnamed tributary to the Little Yadkin River at SR 1168 in Stokes County, $n=2$, (Bartone 1972) (Figure 4). Another early record was from the Ararat River at NC 103/89 in Surry County, collected by Joe Mickey and NCWRC staff on October 08, 1981, $n=1$. The closest possible source population(s) from which the Mountain Redbelly Dace may have originated is (are) from the Dan River (Roanoke River drainage). Nonindigenous populations are also found in the New River drainage and the Watauga River system (Holston/Tennessee River drainage). Genetic studies could shed light on where these introduced populations originated.

Between 1970 and 2016, 44 collections exist of Mountain Redbelly Dace from the Yadkin-Pee Dee River drainage with the number of specimens represented in each collection ranging from 1 to 539 (the latter from a 600-ft. reach in Pauls Creek at SR 2048 in Surry County, April 08, 2009). Resulting from multiple introductions and natural dispersal, the species is currently found in several of the upper Yadkin River system watersheds in Surry and Stokes counties, including the Little Yadkin, Ararat, and Fisher rivers with disjunct populations in Mulberry Creek and East Prong Roaring River in Wilkes County (Figure 4). It is predicted that the Mountain Redbelly Dace could colonize and disperse throughout the upper and middle reaches of the Yadkin River system where dispersal is not limited by dams (e.g. Kerr Scott, Kapps Mill, Northwest Filter Plant, Idols, Cooleme, and High Rock dams), reservoirs (High Rock), or poor water quality.

ROSEFIN SHINER, *LYTHRURUS* *ARDENS* (COPE, 1868)

The Rosefin Shiner inhabits small to medium-sized upland streams (lotic waters) with moderate flow and usually gravel and rubble bottoms (Snelson 1980). There were no previously published records of this species occurrence in the Yadkin-Pee Dee River drainage. No localities were shown on the map in Snelson (1980) or mentioned in Snelson (1990), Menhinick (1991), or Dimmick et al. (1996). Specimens of Rosefin Shiner were listed in Fowler (1945, page 118), but were later re-identified as Redlip Shiner, $n=7$. The first discovery and earliest records of the Rosefin Shiner were made by DWR staff in April 2001 from Muddy and Silas creeks, two tributaries to the Yadkin River in Forsyth County, $n=3$ and 12, respectively (Figure 5). The closest possible source population from which the Rosefin Shiner may have originated is from the Dan River (Roanoke River drainage).

Between 2001 and 2016, 16 collections exist of Rosefin Shiner from the Yadkin-Pee Dee River drainage with

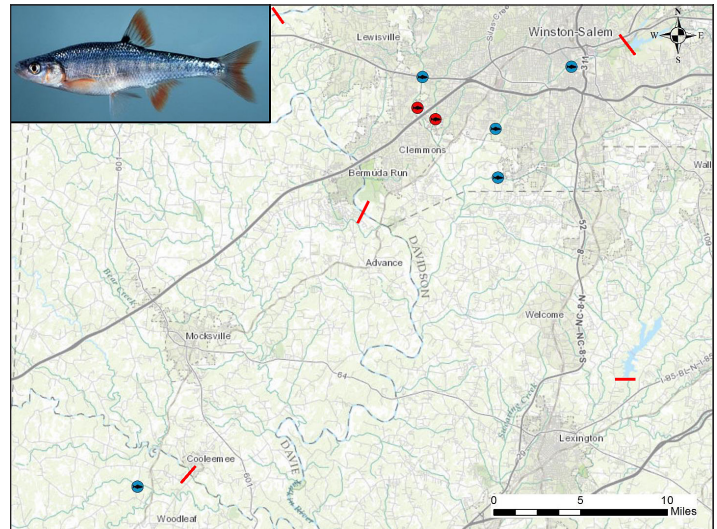


Figure 5. Known distribution of the Rosefin Shiner (*Lythrurus ardens*) in the Yadkin-Pee Dee River drainage in North Carolina as of December 31, 2016. Red symbols denote the first known occurrences and red bars denote dams.

the number of specimens represented in each collection ranging from 1 to 27 (the latter from a 600-ft. reach in Silas Creek at SR 1137 in Forsyth County, April 24, 2002). Currently, populations are known to exist from only four tributaries to the Yadkin River and one tributary to the South Yadkin River in Forsyth and Rowan counties (Figure 5). It is predicted that Rosefin Shiner could colonize and disperse throughout the middle reaches of the Yadkin River system where dispersal is not limited by dams (e.g. Cooleme, Idols, and High Rock dams), reservoirs (High Rock), or poor water quality.

SWALLOWTAIL SHINER, *NOTROPIS* *PROCNE* (COPE, 1865)

The Swallowtail Shiner is another lotic inhabitant found in moderate to low gradient, clear to turbid small streams to large rivers, occupying pools and slow runs with sand, gravel, or rock bottom (Jenkins and Sorensen 1980). There were no published records of this species from the Yadkin-Pee Dee drainage prior to Tatum et al. (1963). Three collections of Swallowtail Shiner from Davie (Cedar Creek) and Montgomery (Belford and Rocky creeks) counties, made on August 27 and 29, 1940, by staff from Academy of Natural Sciences of Philadelphia, were reported in Fowler (1945, page 113). These collections, initially identified as *Notropis procne*, were re-identified as Whitemouth Shiner (*Notropis alborus*, ANSP Catalogue Numbers 75650, 75651, and 75654), a species not described until 1947 by Hubbs and Raney (1947). Jenkins and Sorensen (1980) considered the species localized in the drainage with six locales plotted. However, one of these locales, based upon a specimen collected by Edward D. Cope in 1869 and identified by Henry

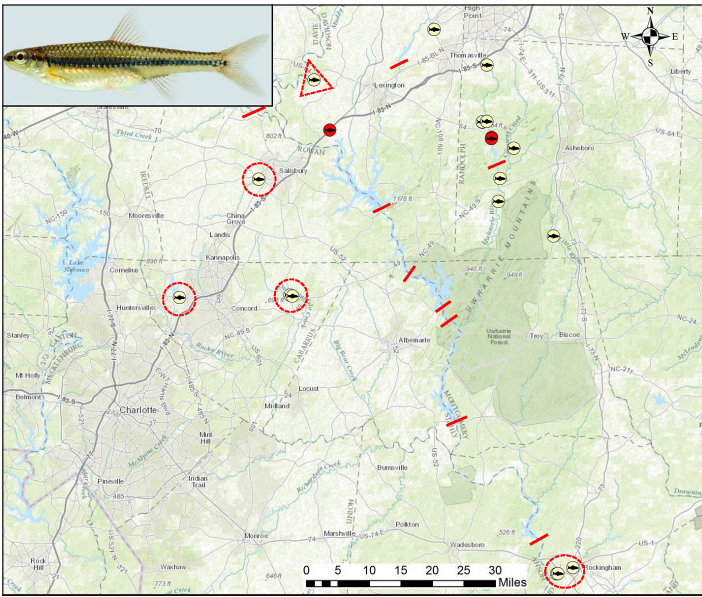


Figure 6. Known distribution of the Swallowtail Shiner (*Notropis procne*) in the Yadkin-Pee Dee River drainage in North Carolina as of December 31, 2016. Red symbols denote the first known occurrence; red bars denote dams, red dashed circles denote unvouchered specimens, and red dashed triangle denotes specimen collected by E. D. Cope in 1869 re-identified by W. C. Starnes in 2007 as Whitemouth Shiner, *Notropis alborus*.

W. Fowler as *Notropis procne*, was re-identified by Wayne C. Starnes as *Notropis alborus* (ANSP Catalogue Number 2027). This locality, Yadkin River (most likely Gobble Creek in Davidson County), is outlined with a red triangle in Figure 6. [Note: Age 1 and young-of-year Spottail Shiner (*Notropis hudsonius*) can easily be confused with pale colored Swallowtail Shiner as can Whitemouth Shiner.] The first accurately identified and reported specimens were collected by Tatum et al. (1963) in July 1960 from the Uwharrie River at US 64 in Randolph County in July 1960, n=22 and from South Potts Creek at US 70 in Davidson County, n=20. The closest possible source population(s) from which Swallowtail Shiner may have originated is(are) from the Dan River (Roanoke River drainage) and the Deep River system (Cape Fear River drainage). Genetic studies could shed light on where these introduced populations originated.

Between 1960 and 2016, 31 collections exist of Swallowtail Shiner from the Yadkin-Pee Dee River drainage with the number of specimens represented in each collection ranging from 1 to 131 (the latter from a 600-ft. reach in Uwharrie River at SR 1406 in Randolph County, June 20, 2011). A disjunct population in the upper Little River (Figure 6) has not been detected since 1999, thus this sub-watershed introduction has most likely failed. Currently, populations exist in the Abbotts Creek and Rocky and Uwharrie River watersheds along with those in Yad-

kin and Pee Dee River tributaries (Grants and Hitchcock creeks and Little River) (Figure 6). Records based upon unvouchered specimens were discovered from Black Run, Coddle, and Dutch Buffalo creeks in Cabarrus County, Grants Creek in Rowan County, and Hitchcock Creek in Richmond County. Uncertainty concerning the native versus nonnative distribution of this species in the Yadkin-Pee Dee River drainage in North Carolina was expressed by Fuller et al. (1999). However, if native, Swallowtail Shiner would be more widely distributed in suitable habitats throughout the middle and lower portions of the drainage. In South Carolina, Swallowtail Shiner is found at only a few localities in the Yadkin-Pee Dee River drainage, including Thompson and Lynches creeks (Rohde et al. 2009). The future distribution of the Swallowtail Shiner is uncertain because it does not seem to have dispersed widely in the middle and lower regions of the drainage where colonization is not hindered by dams and their reservoirs (e.g., Coolemee, Tom-a-Lex, and the Yadkin-Pee Dee River Chain of Lakes) or poor water quality.

COMELY SHINER, *NOTROPIS AMOENUS* (ABBOTT, 1874)

The Comely Shiner’s lotic habitats are variable, but the species is usually found schooling in mid-water in medium- to large-sized creeks and rivers with currents variable from slow to quite fast (Snelson and Gilbert 1980). However, in the Yadkin-Pee Dee drainage in North Carolina, there are four records from 1999 from cove rotenone sampling in Blewett Falls Reservoir (Anson-Richmond counties). There were no published records (e.g., Tatum

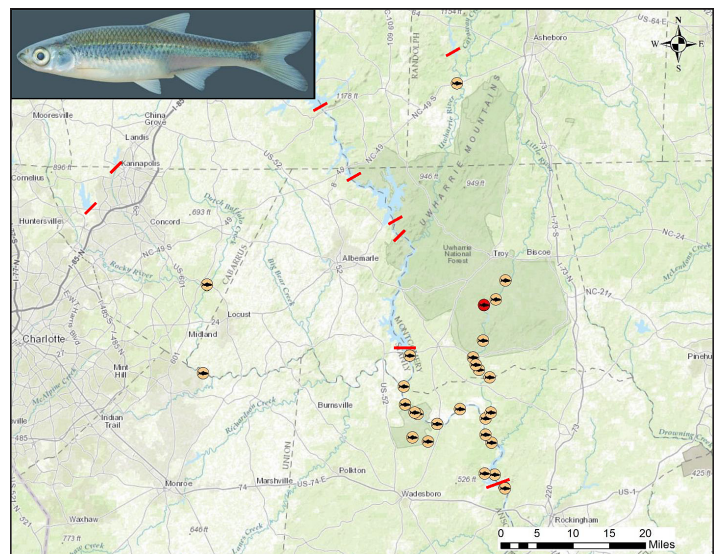


Figure 7. Known distribution of the Comely Shiner (*Notropis amoenus*) in the Yadkin-Pee Dee River drainage in North Carolina as of December 31, 2016. Red symbol denotes the first known occurrence and red bars denote dams.

et al. [1963], Snelson [1968], or Menhinick [1974]) prior to Menhinick (1991) for this species' occurrence in this drainage. The earliest records of Comely Shiner were plotted in Menhinick (1991) from six localities in Richmond, Montgomery, and Anson counties (Figure 7), but voucher material could be found from only one site: Rocky Creek at SR 1543 in Montgomery County, collected by William Palmer and NCSM staff on August 01, 1973, n=33. This record was mentioned in Snelson and Gilbert (1980), but was not plotted on their map. The closest possible source population from which Comely Shiner may have originated is from the Cape Fear River drainage.

Between 1973 and 2016, 48 collections exist of Comely Shiner from the Yadkin-Pee Dee River drainage with the number of specimens represented in each collection ranging from 1 to 88 (the latter from Little River at SR 1519 in Montgomery County, September 09, 1995). A disjunct population in the upper Uwharrie River (Figure 7) has not been detected since 1992, thus this sub-watershed introduction has most likely failed. [Note: Sandbar Shiner can easily be confused with Comely Shiner and any possible Comely Shiners collected should be closely examined or preserved for verification, especially from the Uwharrie River watershed where there is only one record from 1992.] Currently, populations exist in the Rocky River (Menhinick 1996) and Little River watersheds and from several sites along the mainstem of the Pee Dee River downstream from Lake Tillery and Blewett Falls Reservoir (Figure 7). Uncertainty concerning the native versus nonnative distribution of this species in the Yadkin-Pee Dee River drainage in North Carolina was expressed by Fuller, et al. (1999), believing that its native range extended into South Carolina. However, the Comely Shiner is known from only two localities in South Carolina just downstream of the state line on the Pee Dee River, near Cheraw, Chesterfield County (Rohde et al. 2009). It is predicted that the Comely Shiner could colonize and disperse throughout the entire Rocky River watershed where suitable habitat and conditions exist. Further dispersal upstream is blocked by Tillery Dam on the mainstem of the Pee Dee River.

Lastly, when in doubt and whenever possible, voucher your specimens (Tracy 2007a)! You'll leave an easily identifiable trail for future forensic ichthyologists to follow.

ADDITIONAL INTERNET RESOURCES AVAILABLE ON THE USGS NONINDIGENOUS AQUATIC SPECIES WEBSITE

Red Shiner

Fact sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=518>

Animated map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=518>

Point map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=518>

Collection info: <https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=518&State=NC>.

Warpaint Shiner

Fact Sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=562>

Animated map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?SpeciesID=562>

USGS Point map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=562>

Collection info: <https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=562>

Central Stoneroller

Collection info: <https://nas.er.usgs.gov/queries/collectioninfo.aspx?SpeciesID=506>

Point map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=506>

Fact Sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=506>

Animated map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=506>

Mountain Redbelly Dace

Collection Info: <https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=619&State=NC>

Point Map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=619>

Fact sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=619>

Animated Map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=619>

Rosefin Shiner

Collection Info: <https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=565&State=NC>

Point Map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=565>

Fact Sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=565>

Animated Map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?SpeciesID=565>

Swallowtail Shiner

Collection Info: <https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=607&State=NC>

Point Map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=607>

Fact Sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=607>

Animated Map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=607>

Comely Shiner

Collection Info: <https://nas.er.usgs.gov/queries/collectioninfo.aspx?SpeciesID=580>

Point Map: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=580>

Fact Sheet: <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=580>

Animated Map: <https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=580>

Literature Cited

- Bailey, J. R. 1949. Yadkin River survey report. Fish Division. North Carolina Wildlife Resources Commission. Raleigh, NC. 19 pp.
- Bartone, S. A. 1972. Recent capture of *Phoxinus oreas* (Pisces: Cyprinidae) from the Yadkin-Pee Dee River drainage, North Carolina. *Journal of the Elisha Mitchell Scientific Society* 88: 28–29.
- Blum, M. J., D. A. Neely, P. M. Harris, and R. L. Mayden. 2008. Molecular systematics of the cyprinid genus *Campostoma* (Actinopterygii: Cypriniformes): disassociation between morphological and mitochondrial differentiation. *Copeia* 2008 (2): 360–369.
- Bonner, W. R. 1983a. Survey and classification of state-managed trout streams. District Seven. Mountain Fisheries Investigations. Federal Aid in Fish Restoration Project F24-S. North Carolina Wildlife Resources Commission. Raleigh, NC. 110 pp.
- Bonner, W. R. 1983b. Survey and classification of state-managed trout streams. District Eight. Mountain Fisheries Investigations. Federal Aid in Fish Restoration Project F24-S. North Carolina Wildlife Resources Commission. Raleigh, NC. 150 pp.
- Burr, B. M. 1980. *Campostoma anomalum* (Rafinesque), Stoneroller. p 143. *In*: Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Cope, E. D. 1870. A partial synopsis of the fishes of the fresh waters of North Carolina. *Proceedings of the American Philosophical Society* 11: 448–495.
- Dimmick, W. W., K. L. Fiorino, and B. M. Burr. 1996. Reevaluation of the *Lythrurus ardens* (Cypriniformes: Cyprinidae) complex with recognition of three evolutionary species. *Copeia* 1996 (4): 813–823.
- Fowler, H. W. 1945. A study of the fishes of the southern Piedmont and Coastal Plain. Academy of Natural Sciences of Philadelphia. Monograph No. 7. 408 pp + 313 figures.
- Fuller, P. L., L. G. Nico, and J. D. Williams. 1999. Nonindigenous fishes introduced into inland waters of the United States. American Fisheries Society, Special Publication 27. Bethesda, MD. 613 pp.
- Gilbert, C. R. 1964. The American cyprinid fishes of the subgenus *Luxilus* (genus *Notropis*). *Bulletin of the Florida State Museum. Biological Sciences. University of Florida, Gainesville, Fl.* 8:95–194.
- Gilbert, C. R. 1980. *Notropis coccogenis* (Cope), Warpaint Shiner. p 257. Lee, D. S., Gilbert, C. R., Hocutt, C. H., Jenkins, R. E., McAllister, D. E., and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Glantzbecker, G. J., F. Alda, R. E. Broughton, D. A. Neely, R. L. Mayden, and M. J. Blum. 2016. Geographic independence and phylogenetic diversity of Red Shiner introductions. *Conservation Genetics* 17:795–809.
- Herrington, S. J., and D. R. DeVries. 2008. Reproductive and early life history of nonindigenous Red Shiner in the Chattahoochee River drainage, Georgia. *Southeastern Naturalist* 7:413–428.
- Hocutt, C. H., R. E. Jenkins, and J. R. Stauffer, Jr. 1986. Zoogeography of the fishes of the central Appalachians and central Atlantic Coastal Plain. Chapter 6. pp 161–211. *In*: Hocutt, C. H. and E. O. Wiley (eds). The zoogeography of North American freshwater fishes. Wiley and Sons, New York, NY.
- Hubbs, C. L., and E. C. Raney. 1947. *Notropis alborus*, a new cyprinid fish from North Carolina and Virginia. *Occasional Papers of the Museum of Zoology. University of Michigan, Ann Arbor, MI.* 498. 19 pages.
- Jenkins, R. E., and N. M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society. Bethesda, MD. 1080 pp.
- Jenkins, R. E., and D. S. Sorensen. 1980. *Notropis procne* (Cope), Swallowtail Shiner. p 298. *In*: Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Menhinick, E. F. 1991. The freshwater fishes of North Carolina. North Carolina Wildlife Resources Commission. Raleigh, NC. 227 pp.
- Menhinick, E. F. 1996. Studies of streams of the Uwharrie National Forest. Parts 1 and 2. Grant No. 11-544 to E. F. Menhinick, Department of Biology, University of North Carolina at Charlotte. U.S. Department of Agriculture, U.S. Forest Service. Uwharrie National Forest, Troy, NC. 172 pp.
- Menhinick, E. F., T. M. Burton, and J. R. Bailey. 1974. An annotated checklist of the freshwater fishes of North Carolina. *Journal Elisha Mitchell Society* 90: 24–50.

- Mickey, J. H., Jr. 1981. Survey and evaluation of selected Smallmouth Bass and marginal Smallmouth Bass streams located in District Seven, North Carolina. Job 1. Field sampling. Job 2. Final report. Federal Aid in Fish Restoration Project F-24. North Carolina Wildlife Resources Commission. Raleigh, NC. 69 unnumbered pages.
- Moore, R. H., R. A. Garrett, and P. J. Wingate. 1976. Occurrence of the Red Shiner, *Notropis lutrensis*, in North Carolina: a probable aquarium release. Transactions of the American Fisheries Society 105:220–221.
- Outten, L. M. 1957. A study of the life history of the cyprinid fish *Notropis coccogenis*. Journal of the Elisha Mitchell Society. 73:68–84.
- Phillips, R. E., Jr. 1980. Some biotic and abiotic factors affecting the distribution of fishes in the upper Yadkin River. Masters of Science thesis. Appalachian State University, Boone, NC. 64 pp.
- Ramsey, J. S. 1965. Zoogeographic studies on the freshwater fish fauna of rivers draining the southern Appalachian region. Doctoral dissertation. Tulane University, New Orleans, LA. 129 pp.
- Rohde, F. C., R. G. Arndt, J. M. Foltz, and J. M. Quattro. 2009. Freshwater fishes of South Carolina. University of South Carolina Press. 430 pp.
- Shafland, P. L., K. B. Gestring, and M. S. Stanford. 2008. Categorizing introduced fishes collected from public waters. Southeastern Naturalist. 7: 627–636.
- Smith, H. M. 1907. The fishes of North Carolina. Vol. II. North Carolina Geological Survey. Raleigh, NC. 453 pp.
- Snelson, F. F., Jr. 1968. Systematics of the cyprinid fish *Notropis amoenus*, with comments on the subgenus *Notropis*. Copeia 1968 (4): 776–802.
- Snelson, F. F., Jr. 1980. *Notropis ardens* (Cope), Rosefin Shiner. p 228. In: Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Snelson, F. F., Jr. 1990. Redescription, geographic variation, and subspecies of the minnow *Notropis ardens* (Pisces: Cyprinidae). Copeia 1990 (4): 966–984.
- Snelson, F. F., Jr., and C. R. Gilbert. 1980. *Notropis amoenus* (Abbott), Comely Shiner. p 225. In: Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Starnes, W. C., and L. B. Starnes. 1980. *Phoxinus oreas* (Cope), Mountain Redbelly Dace. p 339. In: Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. eds. Atlas of North American freshwater fishes. North Carolina State Museum Natural History. Raleigh, NC. i-x + 854 pp.
- Tatum, B. L., W. C. Carnes, and F. Richardson. 1963. Survey and classification of the Yadkin River and tributaries, North Carolina. Final report. Federal Aid in Fish Restoration. Job I-B, Project F-14-R. North Carolina Wildlife Resources Commission. Raleigh, NC. (Appendix A and Appendix B). 144 pp.
- Tracy, B. H. 2007a. The importance of voucher material. Newsletter of the North Carolina Chapter of the American Fisheries Society. March 2007. pages 6–7.
- Tracy, B. H. 2007b. 1 out of 3 ain't bad (the nonindigenous fishes of the Yadkin-Pee Dee River basin). The Virginia and North Carolina Chapters of the American Fisheries Society. 2007 Meeting. February 26–28, 2007. Danville, VA.
- Tracy, B. H. 2008. What are Piedmont and Coastal Plain species doing in the French Broad River basin? Newsletter of the North Carolina Chapter of the American Fisheries Society. March 2008. pages 5–9.
- Tracy, B. H. 2009. Bluehead Chub, *Nocomis leptoccephalus* (Girard 1856), first species of freshwater fish scientifically described from North Carolina. Newsletter of the North Carolina Chapter of the American Fisheries Society. December 2009. pages 6–10.
- Tracy, B. H. 2013. Bluehead Chub, *Nocomis leptoccephalus* (Girard 1856), the first species of freshwater fish scientifically described from North Carolina. American Currents. 38:2–8.
- Tracy, B. H., R. E. Jenkins, and W. C. Starnes. 2013. History of fish investigations in the Yadkin-Pee Dee River drainage of North Carolina and Virginia with an analysis of nonindigenous species and invasion dynamics of three species of suckers (Catostomidae). Journal of the North Carolina Academy of Science 129: 82–106.
- Tracy, B. H., and P. Schneider. 2009. The Oriental Weatherfish in North Carolina. Newsletter of the North Carolina Chapter of the American Fisheries Society. December 2009. pages 5–6.
- Walters, D. M., M. J. Blum, B. Rashleigh, B. J. Freeman, B. A. Porter, and N. M. Burkhead. 2007. Red Shiner invasion and hybridization with Blacktail Shiner in the upper Coosa River, USA. Biological Invasions 10:1229–1242.

Zimmerman's Fish



Home
Pricing & Availability
Captive Care

www.ZimmermansFish.com
330-417-9476
Email: smbass444@yahoo.com

Sunfish - Killifish - Minnows - Darters

Phone: (330) 417-9476

Email: smbass444@yahoo.com