

A Summary of the 2010 Reevaluation of Status Listings for Jeopardized Freshwater Fishes in North Carolina

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On behalf of the NCWRC's Scientific Council of Fishes

November 01, 2014



Bigeye Jumprock, *Scartomyzon (Moxostoma) ariommum*, State Threatened
Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Virginia Division of Game and Inland Fisheries
and the Southeastern Fishes Council (<http://www.sefishescouncil.org/>).

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INTRODUCTION

The 15-member North Carolina Wildlife Resources Commission's Scientific Council of Fishes convened one early Saturday morning on January 10, 2009 at NCWRC's headquarters on NCSU's Centennial Campus to update the 2006 status listing of North Carolina's freshwater fish fauna. During a day-long meeting and over the course of several months interspersed with a flurry of e-mails exchanged among members, a "final" report was issued in September 2009. Another "final" report was issued in November 2009. After collecting additional distributional data and supporting information on several key species, a "final final" report was completed for delivery to the NCWRC's Nongame Advisory Committee on November 30, 2010.

As a member of the Council and of the North Carolina Chapter of the American Fisheries Society, I thought that after everyone's diligent work on this document, it should "see the light of day" rather than just reside in a four drawer filing cabinet or on a hard drive somewhere at NCWRC headquarters. I also remembered that Article 1 (b) of the bylaws of the North Carolina Chapter of the American Fisheries Society state: ". . .to encourage exchange of information among Chapter members and with the general public" (http://www.sdafs.org/ncafs/TextContent/procedures/NCAFSBylaws_2010_07_01.pdf). Knowing firsthand how much of a challenge it is to keep a newsletter "fed" and published on schedule, I took it upon myself, with the help of Council members, to re-work the imperiled species support summaries and share this information with Chapter members via the Chapter's newsletter. The Councils' overall recommendations were re-printed in the newsletter's June 2010 issue (<http://www.sdafs.org/ncafs/>) with species summaries appearing in all subsequent newsletters, except one. This 17-part series (the 16 species summaries plus the overall recommendations) was completed with the Fall 2014 issue.

Upon completion of this project and discussing future options with the Newsletter Committee, a decision was made to compile the entire series into one document and post it on the Chapter's webpage. The series is re-printed herein with some very minor changes and edits:

1. a map was added for each species;
2. the Literature Cited and Recommended Readings section and contributing author's and photographer's names were standardized;
3. punctuation, spelling, and publication year errors were corrected; and
4. photographs were standardized to 6.5 inches wide.

What follows in this document is the 2010 report including its supporting tables (pages 4-11) followed by the Council's recommendations (page 13) and the species summaries (pages 14-78) with each page's header showing the original date of publication. An Addendum has been inserted at the end of document.

I hope all NC AFS Members have benefitted from reading this series as much as I have had in writing it. I want to extend a special thanks to contributing co-authors Steve Fraley, Ryan Heise, Brena Jones, Fritz Rohde, and Wayne Starnes; to Fred Harris for supporting this project; and to Kim Baker, Dave Coughlan, Kevin Hining, Brena Jones, Ben Ricks, and Kim Sparks for their constructive reviews and for keeping the Chapter's outstanding newsletter on schedule and well-fed.

2010 REEVALUATION OF STATUS LISTINGS FOR JEOPARDIZED FRESHWATER FISHES IN NORTH CAROLINA

Report of the Scientific Council on Freshwater Fishes

Submitted to the Nongame Advisory Committee to the
North Carolina Wildlife Resources Commission (NCWRC)

November 2010

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The Scientific Council on Freshwater Fishes was asked to reassess the status listings of the rare, threatened, and endangered freshwater fishes, so that the listings would be based on the most current scientific evidence. Members of the Council were in email contact from December 2008 through July 2009, and the Council met the morning of January 10, 2009 and for the entire day on February 10, 2009. Based on our review of currently available information, the Council submits the following 16 changes in designation from the 2006 Council report. The status headings, as given herein, represent our recommendations to the Nongame Wildlife Advisory Committee and North Carolina Wildlife Resources Commission (NCWRC) as to how these species should be regarded in upcoming considerations for listing within the North Carolina Administrative Code.

There are three tables contained within this report. Table 1 provides a listing of all changes in designation from the 2006 report; Table 2 provides a brief rationale for the two species being delisted; and Table 3 provides a history of status listing recommendations for freshwater fishes from 1977-2010. In addition to the recommended actions, the Council identified three longer-term issues that should be addressed before the next iteration of changes occurs. At least two of the issues affect other councils. We recommend that all affected councils participate in addressing these issues in order to achieve consistency among councils in making listing decisions.

Diadromous Species

At least four species of diadromous fishes (Alewife, *Alosa pseudoharengus*, Atlantic Sturgeon, *Acipenser oxyrinchus*, Blueback Herring, *Alosa aestivalis*, and Sea Lamprey, *Petromyzon marinus*) appear to be reduced in numbers to the extent that their consideration for listing appears warranted (Table 3). The North Carolina General Statutes §113-331 to §113-334 that govern listing of animals are unclear on the listing of diadromous fishes. Animals that depend on coastal waters for a part of their life cycle are excluded from the animals that the NCWRC can list. We need to determine if such species can be listed at all, listed only in inland waters by the NCWRC, or listed only in inland waters by the NCWRC with the concurrence of the Marine Fisheries Commission.

Development of a More Quantitative Criteria for Listing

The Council discussed the desirability of developing quantitative criteria for determining listing status to bring more transparency and objectivity to listing decisions. We see considerable benefits to having such criteria, but we believe that such criteria would need to be adopted and used by all of the councils. We recommend that the council chairs consider the concept and determine if quantitative criteria for listing animals should be developed and used for the 2015 list modifications. For aquatic animals, numerical rating criteria might include: 1) number of extant populations, 2) number of North Carolina Division of Water Quality (NCDWQ) subbasins or U. S. Geological Survey (USGS) hydrologic units occupied, 3) number of NCDWQ subbasins or USGS hydrologic units lost, 4) range and abundance in adjacent states, 5) barriers to recolonization from adjacent states, 6) abundance in remaining North Carolina populations, 7) evidence of decreasing abundance or poor recruitment, 8) range of stream sizes occupied, 9) seasonal migration needs, 10) threat of habitat alteration in remaining populations, 11) threat of introduced species, disease or climate change, and 12) difficulty of sampling and reliability of survey data.

Development of a Consistent Approach among Councils for Listing Peripheral and Extirpated Species

The Council discussed the treatment of peripheral and extirpated species in the listing process. Peripheral species are those whose ranges fall mainly outside of North Carolina and hence may be present in North Carolina in low numbers, or in small pockets of higher density near the state borders, but are common in one or more adjacent states. Since these populations contribute to the wildlife diversity of the state and may be important to the genetic diversity of the species, we recommend that all councils evaluate such populations according to their abundance in North Carolina and propose listing statuses based on those evaluations.

Extirpated species become problematic due in large part to the wording in General Statute §113-331(2) that defines endangered species (and by inference threatened and special concern species) as “any native or once-native species...” determined to be in jeopardy. We are unclear as to the legislative intent for listing once-native species. The Council’s consideration of extirpated species finally centered on the

period of time such species should continue to be listed after the data indicate they are no longer present in North Carolina and are unlikely to recolonize. We recommend that all councils should use consistent criteria in deciding to list or not list extirpated species.

The following detailed reports are provided for those species that are being added to the list for the first time as well as those species being uplisted or downlisted. The Roanoke Logperch, *Percina rex* (Jordan and Evermann), a federally Endangered species, is also being added to the state list for the first time. All native or resident wild animals which are on the federal lists of endangered or threatened species pursuant to the Endangered Species Act have the same status on the North Carolina protected animal lists (North Carolina General Statute §113-334(a)). The Roanoke Logperch was only recently discovered (2007-2009) in North Carolina in Rockingham County in the Dan, Smith, and Mayo rivers and in Big Beaver Island Creek.

Literature Cited

Braswell, A. L. 1991. Scientific council report on the conservation status of North Carolina freshwater fishes. Prepared by the Freshwater Fishes Scientific Council. Submitted to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission. Raleigh, NC.

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Cooper, J. E., Robinson, S. S., and J. B. Funderburg. 1977. Endangered and threatened plants and animals of North Carolina. North Carolina State Museum of Natural History. Raleigh, NC. 444 pp.

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Table 1. Proposed status changes to the rare, threatened, and endangered freshwater fishes of North Carolina.

Common Name	Scientific Name	Current Status	Proposed Status
American Brook Lamprey	<i>Lampetra appendix</i>	Threatened	Endangered
Banded Sculpin	<i>Cottus carolinae</i>	Threatened	Endangered
"Atlantic" Highfin Carpsucker	<i>Carpionodes sp. cf. velifer</i>	Special Concern	Endangered
Mountain Madtom	<i>Noturus eleutherus</i>	Special Concern	Endangered
Ohio Lamprey	<i>Ichthyomyzon bdellium</i>	Not Listed	Special Concern
Roanoke Logperch	<i>Percina rex</i>	Not Listed	Endangered
Tennessee Darter ¹	<i>Etheostoma tennesseense</i>	Special Concern	Endangered
Sharpnose Darter	<i>Percina oxyrhynchus</i>	Special Concern	Endangered
"Broadtail" Madtom	<i>Noturus sp. cf. leptacanthus</i>	Special Concern	Threatened
"Lake Phelps" Killifish	<i>Fundulus sp. cf. diaphanus</i>	Not Listed	Threatened
Thinlip Chub	<i>Cyprinella sp. cf. zanema</i>	Special Concern	Threatened
Waccamaw Killifish	<i>Fundulus waccamensis</i>	Special Concern	Threatened
Blackbanded Darter	<i>Percina nigrofasciata</i>	Threatened	Special Concern
Mimic Shiner	<i>Notropis volucellus</i>	Not Listed	Special Concern
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	Special Concern	Delisted ²
Riverweed Darter	<i>Etheostoma podostemone</i>	Special Concern	Delisted

¹Formerly listed as Tennessee Snubnose darter, *Etheostoma simoterum* (Cope).

²Under evaluation pending a legal review of the General Statutes.

Table 2. Rationales for removals of species from the list of designated species.

Common Name	Scientific Name	Current Status	Proposed Status	Reasoning
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	Special Concern	Delist	The General Statutes that govern listing of animals are unclear on the listing of diadromous fishes. Pending a legal review of the statutes, the status of the Atlantic sturgeon will be down listed from Special Concern to Delist
Riverweed Darter	<i>Etheostoma podostemone</i>	Special Concern	Delist	Recent data indicate populations are strong in Smith and upper Dan rivers and their tributaries and are at levels for which there is no reason to continue listing them

Table 3. History of status listing recommendations for freshwater fishes in North Carolina. Listings for 1977 (Cooper *et al.* 1977) predate endangered wildlife legislation and thus had no legal status but formed a working basis for subsequent status reviews. Those for 1991 were based on the first report (Braswell 1991) of the Scientific Council on Freshwater Fishes to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (fishes council formed in 1988 pursuant to the endangered wildlife law of 1987, House Bill 664); recommendations were legislated verbatim April 1991. Those for 1997 were based on recommendations (three status emends, six nomenclature updates, no changes for others) submitted by letter to the Committee authored by A. L. Braswell (outgoing Council chair) and W. C. Starnes (incoming Council chair), November 19, 1997, which were enacted April 01, 2001. Council report (Starnes *et al.*) of November 2006 to Nongame Committee is basis for that year, followed by current recommendations for 2010.

Common Name	Scientific Name	Year				
		1977	1991	1997	2006	2010
Alewife	<i>Alosa pseudoharengus</i>	---	---	---	---	Under Evaluation (Diadromous species) (Native populations only)
American Brook Lamprey	<i>Lampetra appendix</i>	---	Threatened	Threatened	Threatened	Endangered
Appalachia Darter (formerly listed as Blackside Darter)	<i>Percina gymnocephala</i> (formerly listed as <i>P. maculata</i>)	Special Concern	---	---	---	---
"Atlantic" Highfin Carp sucker ¹	<i>Carpiodes sp. cf. velifer</i> ¹	---	Special Concern (as <i>C. velifer</i>)	Special Concern (as <i>C. velifer</i>)	Special Concern	Endangered
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	Special Concern (as <i>A. oxyrinchus</i>)	Special Concern (as <i>A. oxyrinchus</i>)	Special Concern (as <i>A. oxyrinchus</i>)	Special Concern (Spelling update)	Under Evaluation (Diadromous species)
Banded Sculpin	<i>Cottus caroliniae</i>	---	Threatened	Threatened	Threatened	Endangered
Bigeye Jumrock	<i>Scartomyzon ariommus</i> (formerly listed as <i>Moxostoma ariommum</i>)	Special Concern	Special Concern	Threatened (Nomenclature update)	Threatened	Threatened
Bigmouth Chub	<i>Nocomis platyrhynchus</i>	Special Concern	---	---	---	---
Blackbanded Darter	<i>Percina nigrofasciata</i>	---	---	---	Threatened	Special Concern
Blotchsided Logperch	<i>Percina burtoni</i>	Endangered ²	Endangered	Endangered	Endangered	Endangered
Blueback Herring	<i>Alosa aestivalis</i>	---	---	---	---	Under Evaluation (Diadromous species) (Native populations only)
Bluefin Killifish	<i>Lucania goodei</i>	---	Special Concern	Special Concern	Special Concern ³	Special Concern ³
Bluehead Chub	<i>Nocomis leptocephalus interocularis</i>	Special Concern (Savannah basin form only)	---	---	---	---
Blue Ridge Sculpin	<i>Cottus caeruleomentum</i>	---	---	---	Special Concern	Special Concern
Blueside Darter	<i>Etheostoma jessiae</i>	Endangered	Special Concern	Special Concern	Special Concern	Special Concern (X) ⁴
Bluntnose Minnow	<i>Pimephales notatus</i>	Special Concern	---	---	---	---
Bridle Shiner	<i>Notropis bifrenatus</i>	Endangered ²	Special Concern	Special Concern	Endangered (Not extirpated)	Endangered (Not extirpated)
"Broadtail" Madtom	<i>Noturus sp. cf. leptacanthus</i>	Special Concern	Special Concern	Special Concern	Special Concern	Threatened
Cape Fear Shiner	<i>Notropis mekistocholas</i>	Special Concern	Endangered	Endangered	Endangered	Endangered
Carolina Darter	<i>Etheostoma collis</i>	Special Concern	Special Concern	Special Concern	Special Concern	Special Concern

Table 3 (continued).

Common Name	Scientific Name	Year				
		1977	1991	1997	2006	2010
Carolina Madtom	<i>Noturus furiosus</i>	Special Concern	Special Concern (Neuse basin only)	Special Concern (Neuse basin only)	Threatened	Threatened
Carolina Pygmy Sunfish	<i>Elassoma boehlkei</i>	---	Threatened	Threatened	Threatened	Threatened
"Carolina" Redhorse	<i>Moxostoma</i> sp. cf. <i>erythrurum</i>	---	---	---	Threatened	Threatened
Cutlip Minnow	<i>Exoglossum maxillingua</i>	Special Concern	Endangered	Endangered	Special Concern	Special Concern
Dusky Darter ³	<i>Percina sciera</i>	Special Concern	Endangered	Endangered	Endangered	Endangered
Freshwater Drum	<i>Aplodinotus grunniens</i>	---	Threatened	Threatened	Special Concern (French Broad basin only)	Special Concern (French Broad basin only)
Kanawha Darter	<i>Etheostoma kanawhae</i>	Threatened	---	---	---	---
Kanawha Minnow	<i>Phenacobius teretulus</i>	Threatened	Special Concern	Special Concern	Special Concern	Special Concern
"Lake Phelps" Killifish ⁵	<i>Fundulus</i> sp. cf. <i>diaphanus</i> ⁴	---	---	---	---	Threatened (New listing)
Lake Sturgeon	<i>Acipenser fulvescens</i>	Extirpated?	Special Concern	Special Concern	Special Concern	Special Concern (X) ⁴
Least Brook Lamprey	<i>Lampetra aepyptera</i>	Special Concern	---	Threatened	Threatened	Threatened
Least Killifish	<i>Heterandria formosa</i>	---	Special Concern	Special Concern	Special Concern	Special Concern
Logperch	<i>Percina caprodes</i>	Threatened	Threatened	Threatened	Threatened	Threatened
Longear Sunfish	<i>Lepomis megalotis</i>	Not Listed (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶
Mimic Shiner	<i>Notropis volucellus</i>	---	---	---	---	Special Concern (New listing)
Mooneye	<i>Hiodon tergisus</i>	Endangered	Special Concern	Special Concern	Special Concern	Special Concern
Mountain Madtom	<i>Noturus eleutherus</i>	Extirpated?	Special Concern	Special Concern	Special Concern	Endangered
Muskellunge	<i>Esox masquinongy</i>	Extirpated?	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶
New River Shiner	<i>Notropis scabriceps</i>	Special Concern	---	---	---	---
Ohio Lamprey	<i>Ichthyomyzon bdellium</i>	---	---	---	---	Special Concern (New listing)
Olive Darter	<i>Percina squamata</i>	Threatened (Toe River) Special Concern (elsewhere)	Special Concern	Special Concern	Special Concern	Special Concern
Orangefin Madtom	<i>Noturus gilberti</i>	Threatened	Endangered	Endangered	Endangered	Endangered
Paddlefish	<i>Polyodon spathula</i>	Endangered	Endangered	Endangered	Endangered	Endangered
Pinewoods Darter	<i>Etheostoma mariae</i>	Special Concern	Special Concern	Special Concern	Special Concern	Special Concern
Redeye Bass	<i>Micropterus coosae</i>	Special Concern	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶
River Carpsucker	<i>Carpiodes carpio</i>	Special Concern	Special Concern	Special Concern	Special Concern	Special Concern
Riverweed Darter	<i>Etheostoma podostemone</i>	Special Concern	Special Concern	Special Concern	Special Concern	---
Roanoke Bass	<i>Ambloplites cavifrons</i>	Special Concern	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶
Roanoke Hogsucker	<i>Hypentelium roanokense</i>	Special Concern	---	---	---	---

Table 3 (continued).

Common Name	Scientific Name	Year				
		1977	1991	1997	2006	2010
Roanoke Logperch	<i>Percina rex</i>	---	---	---	---	Endangered (New listing)
Robust Redhorse	<i>Moxostoma robustum</i>	---	Special Concern (as <i>M. carinatum</i>)	Not Listed (Probably extirpated)	Endangered (Not extirpated)	Endangered (Not extirpated)
Rosyface Chub	<i>Hybopsis rubrifrons</i>	Special Concern	Threatened	Threatened	Threatened	Threatened
Highland Shiner (formerly listed as Rosyface Shiner)	<i>Notropis micropteryx</i> (formerly listed as <i>N. rubellus</i>)	Special Concern	---	---	---	---
Rustyside Sucker	<i>Thoburnia hamiltoni</i> (formerly listed as <i>Moxostoma hamiltoni</i>)	---	Endangered	Endangered (Nomenclature update)	Endangered	Endangered
Sandhills Chub	<i>Semotilus lumbee</i>	Special Concern (as <i>Semotilus n. sp.</i>)	Special Concern	Special Concern	Special Concern	Special Concern
Sea Lamprey	<i>Petromyzon marinus</i>	---	---	---	---	Under Evaluation (Diadromous species)
Seagreen Darter	<i>Etheostoma thalassinum</i>	Special Concern	---	---	---	---
Sharphead Darter	<i>Etheostoma acuticeps</i>	Extirpated?	Threatened	Threatened	Threatened	Threatened
Sharpnose Darter	<i>Percina oxyrhynchus</i>	Special Concern (as <i>P. oxyrhyncha</i>)	Special Concern (as <i>P. oxyrhyncha</i>)	Special Concern (Spelling update)	Special Concern	Endangered
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	---	Endangered	Endangered	Endangered	Endangered
Sickle Darter (formerly listed as Longhead Darter)	<i>Percina williamsi</i> (formerly listed as <i>P. macrocephala</i>)	Endangered ²	Special Concern	Special Concern	Special Concern	Special Concern (X) ⁴
"Sicklefin" Redhorse	<i>Moxostoma sp. cf. macrolepidotum</i>	---	---	Under evaluation	Threatened	Threatened
"Smoky" Dace (formerly listed as "Little Tennessee" Rosyside Dace) ⁷	<i>Clinostomus sp. cf. funduloides</i> ⁷	---	Special Concern (as <i>Clinostomus funduloides</i> ssp.)	Special Concern (as <i>C. funduloides</i> ssp.)	Special Concern	Special Concern
Spotfin Chub (Also Known As Turquoise Shiner)	<i>Cyprinella monacha</i> (formerly listed as <i>Hybopsis monacha</i> ; also known as <i>Erimonax monachus</i>)	Extirpated?-French Broad; Endangered-Little Tennessee	Threatened	Threatened (Nomenclature update)	Threatened	Threatened
Spotted Bass	<i>Micropterus punctulatus</i>	Special Concern (Native populations only)	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶	No Status (Game species) ⁶
Stonecat	<i>Noturus flavus</i>	---	Endangered	Endangered	Endangered	Endangered
Striped Shiner	<i>Luxilus chrysocephalus</i> (formerly listed as <i>N. chrysocephalus</i>)	---	Threatened	Threatened (Nomenclature update)	Special Concern	Special Concern
Tangerine Darter	<i>Percina aurantiaca</i>	Special Concern	---	---	---	---
Tennessee Darter (formerly listed as Tennessee Snubnose Darter)	<i>Etheostoma tennesseense</i> (formerly listed as <i>E. simoterum</i>)	Extirpated?	Special Concern	Special Concern	Special Concern	Endangered

Table 3 (continued).

Common Name	Scientific Name	Year				
		1977	1991	1997	2006	2010
"Thinlip" Chub ^{6b}	<i>Cyprinella</i> sp. cf. <i>zanema</i> ⁹	Special Concern (as <i>Hybopsis</i> new sp I & II)	Special Concern (as <i>Hybopsis</i> sp.)	Special Concern (as <i>C. zanema</i> form)	Special Concern	Threatened
Tonguetied Minnow	<i>Exoglossum laurae</i>	Special Concern	---	---	---	---
Turquoise Darter	<i>Etheostoma inscriptum</i>	Special Concern	Special Concern	Special Concern	Threatened	Threatened
Waccamaw Darter	<i>Etheostoma perlongum</i>	Endangered	Threatened	Threatened	Threatened	Threatened
Waccamaw Killifish	<i>Fundulus waccamensis</i>	Endangered	Special Concern	Special Concern	Special Concern	Threatened
Waccamaw Silverside	<i>Menidia extensa</i>	Endangered	Threatened	Threatened	Threatened	Threatened
Wounded Darter (formerly listed as Spotted Darter)	<i>Etheostoma vulneratum</i> (formerly listed as <i>E. maculatum</i>)	Extirpated (French Broad) Special Concern (Little Tennessee)	Special Concern	Special Concern	Special Concern	Special Concern
Yellowfin Shiner	<i>Notropis lutipinnis</i>	---	Special Concern (Savannah and Little Tennessee basins)	Special Concern (Savannah and Little Tennessee basins)	Special Concern (Savannah basin only)	Special Concern (Savannah basin only)
Totals		51 (10 E, 5 T, 29 SC, 7 Extirpated?)	54 (8 E, 12 T, 29 SC, 5 no status)	54 (8 E, 14 T, 26 SC, 5 no status, 1 under evaluation)	58 (9 E, 17 T, 27 SC, 5 no status)	64 (16 E, 17 T, 22 SC, 5 no status, 4 under evaluation)

¹Atlantic Slope populations are regarded as probably distinct from Gulf Slope populations and Council recommends they be referred to as *Carpoides* sp. cf. *velifer* with provisional name emended to "Atlantic" Highfin Carpsucker. Recent data suggests a higher protection category is warranted (recommended herein).

²As Endangered or possibly extirpated.

³Pending more genetic information, Council is considering delisting due to possible introduced status.

⁴Special Concern (X) = Special Concern extirpated; apparently extirpated, but a formerly persistent population probably occurred in North Carolina and re-introduction is possible.

⁵Lake Phelps population is regarded as genetically distinct from the Waccamaw Killifish and Council recommends the undescribed species be referred to as *Fundulus* sp. cf. *diaphanus*, with provisional name emended to "Lake Phelps" Killifish. Recent data suggests a higher protection category is warranted (recommended herein).

⁶Game species are defined in North Carolina General Statute §113-331(10) and North Carolina Administrative Code 15A NCAC 10C.0301.

⁷This species is currently regarded as distinct at the species level from *Clinostomus funduloides* and the Council recommends it be referred to as *Clinostomus* sp. cf. *funduloides*, the "Smoky" Dace, a term in wider use among colleagues than the previously used "Little Tennessee" Rosyside Dace and because it also occurs in the Hiwassee River system.

⁸North Carolina Administrative Code lists this species as *C. zanema* but this name definitely applies only to Santee River drainage (Broad River and Catawba River systems) populations, whose proper common name is Santee Chub and which currently are not deemed in jeopardy. "Thinlip" Chub applies to the probably taxonomically distinct and jeopardized populations in the Cape Fear River and Lumber River drainages and are best referred to as *Cyprinella* sp. cf. *zanema*.

⁹Based upon misidentified specimens, refer to the March 2011 Newsletter of the North Carolina Chapter of the American Fisheries Society (http://www.sdafs.org/ncafs/Newsletters/March2011/March2011_Newsletter_DJC.pdf); column totals (Total) were changed were to correct this error by BHT on May 20, 2014.

**SUMMARIES FROM THE 2010 REEVALUATION OF STATUS LISTINGS
FOR JEOPARDIZED FRESHWATER FISHES IN NORTH CAROLINA**

(listed by issue of the Newsletter of the North Carolina Chapter of the American Fisheries Society)

**Recent Activities of NCWRC’s Scientific Council of Fishes
Submitted by Bryn H. Tracy**

In North Carolina, there are approximately 215 indigenous, described and undescribed species of freshwater fish. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22). It is the responsibility of the Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission if changes in imperilment for any species are warranted. The Council is comprised of 15 members from state and federal regulatory and resources agencies, industry representatives, private consultants, and academicians.

In 2008 and 2009, the Council met to reassess the status of the state’s fauna so that the listings would be based on the most current scientific evidence. The list was last updated in 2006 and codified into rule in 2008. The Council has proposed 16 changes in designations from the 2006 report:

Table 1. Proposed status changes to the rare, threatened, and endangered freshwater fishes of North Carolina.

Common Name	Scientific Name	Current Status	Proposed Status
American Brook Lamprey	<i>Lampetra appendix</i>	Threatened	Endangered
Banded Sculpin	<i>Cottus carolinae</i>	Threatened	Endangered
“Atlantic” Highfin Carpsucker	<i>Carpiodes</i> sp. cf. <i>velifer</i>	Special Concern	Endangered
Mountain Madtom	<i>Noturus eleutherus</i>	Special Concern	Endangered
Ohio Lamprey	<i>Ichthyomyzon bdellium</i>	Not Listed	Special Concern
Roanoke Logperch ¹	<i>Percina rex</i>	Not Listed	Endangered
Tennessee Darter ²	<i>Etheostoma tennesseense</i>	Special Concern	Endangered
Sharpnose Darter	<i>Percina oxyrhynchus</i>	Special Concern	Endangered
“Broadtail” Madtom	<i>Noturus</i> sp. cf. <i>leptacanthus</i>	Special Concern	Threatened
“Lake Phelps” Killifish	<i>Fundulus</i> sp. cf. <i>diaphanus</i>	Not Listed	Threatened
Thinlip Chub	<i>Cyprinella</i> sp. cf. <i>zanema</i>	Special Concern	Threatened
Waccamaw Killifish	<i>Fundulus waccamensis</i>	Special Concern	Threatened
Blackbanded Darter	<i>Percina nigrofasciata</i>	Threatened	Special Concern
Mimic Shiner	<i>Notropis volucellus</i>	Not Listed	Special Concern
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	Special Concern	Delisted ³
Riverweed Darter	<i>Etheostoma podostemone</i>	Special Concern	Delisted

¹A federally listed Endangered species discovered in North Carolina in 2007-2009 in the Dan, Smith, and Mayo rivers and in Big Beaver Island Creek in Rockingham County.

²Formerly listed as Tennessee Snubnose Darter, *Etheostoma simoterum* (Cope), discovered in 2009 in Shut-in Creek, Madison County.

³Under evaluation pending a legal review of the General Statutes.

Please note: these recommendations are tentative. If reviews by the Committee and the Commission are favorable, the list of proposed changes will wind its way through the legislative process and ultimately be codified into rule in the North Carolina Administrative Code

(<http://ncrules.state.nc.us/ncac/title%2015a%20-%20environment%20and%20natural%20resources/chapter%2010%20-%20wildlife%20resources%20and%20water%20safety/subchapter%20i/subchapter%20i%20rules.html>).



From left to right: Mountain Madtom, proposed State Endangered; Tennessee Darter, proposed State Endangered, and Riverweed Darter, proposed Delisted. Photographs by Noel Burkhead and Robert Jenkins and by Richard T. Bryant and Wayne C. Starnes, courtesy of Virginia Polytechnic Institute and State University (<http://www.cnr.vt.edu/efish/>).

North Carolina's Imperiled Fish Fauna, Part I
Submitted by Bryn H. Tracy
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's June 2010 newsletter, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission if changes in imperilment for any species are warranted. The Council is comprised of Fred Harris, Chair, Dave Coughlan, Steve Fraley, Ryan Heise, Gabriela Hogue, Tom Kwak, Wilson Laney, Sarah McRae, Gerald Pottner, Angie Rodgers, Fritz Rohde, Wayne Starnes, Bryn Tracy, Scott Van Horn, and Gene Vaughan. To communicate our findings with the NC AFS membership, this is the first of many articles on the species that the Council believes have become more imperiled since the last listing in 2006.

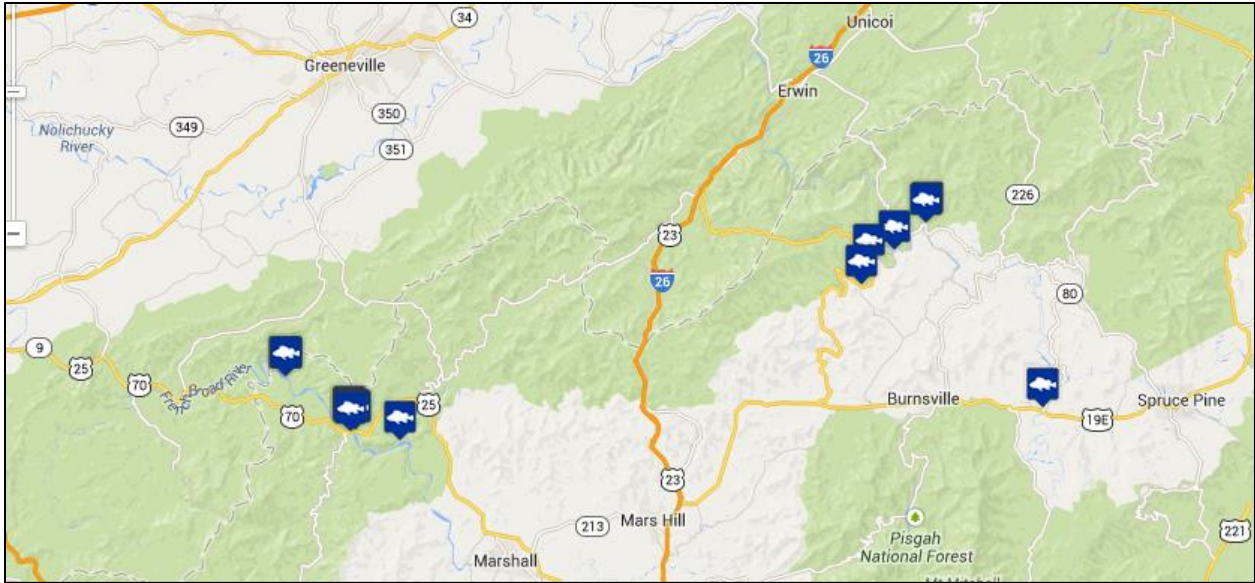
Ohio Lamprey, *Ichthyomyzon bdellium* (Jordan)
Current Status: Not Listed, Proposed Status: Special Concern



Photograph by Uland Thomas, courtesy of the North American Native Fishes Association and the Southeastern Fishes Council (<http://ichthyology.usm.edu/sfc/index.php>)

Description: Lampreys are eel shaped fishes lacking scales, jaws, and paired fins. They have a funnel-shaped mouth, seven gill apertures on each side of the body, a single median nostril, and a cartilaginous skeleton. The Ohio Lamprey has a continuous or shallowly notched dorsal fin. Adults have 53-62 trunk myomeres, usually 56-58; inner lateral teeth bicuspid with the transverse lingual lamina strongly bilobed in anterodorsal view; and the color is uniformly dark gray to olivaceous above, the ventral surface pale, often flushed with yellow. Adults range from approximately 125 mm to 300 mm, total length.

Range – As the common name implies, the Ohio Lamprey is found throughout the Ohio River system, including the Allegheny, Wabash, and upper Tennessee River drainages (Rohde and Lantaigne-Courchene 1980). To the west in Tennessee, the species is found in the Cumberland and Tennessee River drainages and is fairly common in rivers of east Tennessee (Etnier and Starnes 1993). To the north in Virginia, the species is found in the Holston and the Clinch-Powell River systems (Jenkins and Burkhead 1994). Listed as probably occurring in North Carolina (Menhinick *et al.* 1974), the Ohio Lamprey was unknown from North Carolina until May 1994 when four adults, 1 male and 3 females, were collected from the mouth of Spring Creek near the Town of Hot Springs in Madison County (Rohde *et al.* 1998; North Carolina State Museum [NCSM] Catalogue No. 26291). A year later in late April 1995, 6 specimens were collected from this same locality on Spring Creek and an additional 2 specimens were collected one river kilometer upstream on the creek (Rohde *et al.* 1998). Since then, the species has been collected in 1997 from Pigeonroost Creek, a tributary to the lower North Toe River, in Mitchell County (NCSM 44183), in 2006-2008 from the French Broad River at and downstream of the Town of Hot Springs (NCSM 45785, 46145, and 50198), in 2007 and 2009 from Spring Creek at the Town of Hot Springs (NCSM 52382, 55212, and 55214), in 2007 from Big Laurel Creek in Madison County (NCSM 52383), and in 2007 from the South Toe River in Yancey County (NCSM 52478).



Distribution of the Ohio Lamprey in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of 18 records.

Ammocoetes have been collected recently from several localities in the Nolichucky River system in NC that may be Ohio Lamprey (S. Fraley, pers. com.). Anecdotal evidence and photographs from anglers, including one adult specimen collected from the Nolichucky River at Poplar (Mitchell County), suggest that the species has become fairly common throughout the reach from the South Toe River to the Tennessee state line (Jacob Rash, NCWRC, pers. com.). Many specimens of large sucker species. (i.e., *Moxostoma* and *Ictiobus*), and other large fishes collected in 2007 and 2008 at two localities near Hot Springs and one locality just below Redmon Dam (Madison County) on the lower French Broad River had wounds and scars consistent with lamprey predation (S. Fraley, pers. com.). Anecdotal reports from anglers also indicate that Ohio Lamprey may be common to abundant in the French Broad River from Redmon Dam to the Tennessee state line. Adult specimens were collected in the lower Cane River in Yancey County in May 2010.

Habitat – Ammocoetes prefer slow areas of creeks and small rivers with soft substrates and high detritus content; adults occupy the main channels of medium- to large-sized rivers and the adults may ascend tributaries to spawn (Rohde and Lanteigne-Courchene 1980; Jenkins and Burkhead 1994).

Life History and Ecology – A parasitic species as an adult; hosts include Paddlefish, Common Carp, River Chub, Smallmouth Buffalo, Black Buffalo, redbone suckers, Northern Hog Sucker, Channel Catfish, Blue Catfish, Stonecat, Rainbow Trout, Brown Trout, Smallmouth Bass, Largemouth Bass, and Wounded Darter (Jenkins and Burkhead 1994; S. Fraley, pers. com.). The ammocoetes are filter feeders upon detritus, phytoplankton, and microzooplankton. The lifespan is approximately four years as an ammocoete and two years as an adult with spawning occurring during the second spring and early summer of adult life (Rohde and Lanteigne-Courchene 1980).

Rationale for Designation – The Ohio Lamprey is another example of a peripheral species whose distribution in North Carolina is limited, but is more abundant in neighboring states. In North Carolina, the Ohio Lamprey is known from vouchered specimens primarily from the French Broad River and Spring Creek near the Town of Hot Springs in Madison County and from two widely separated locations in the Nolichucky River system. The Spring Creek watershed was recently afforded supplemental water quality classification by the Division of Water Quality as Outstanding Resource Waters.

The Ohio Lamprey's occurrence in North Carolina has only been documented during the past 15 years. Whether it has recently colonized the lower French Broad and the Nolichucky River systems due to improving water quality, larval habitat suitability, or adult host availability is unknown. The species is present and at least locally common to abundant in the French Broad River from the state line upstream to Redmon Dam and in the Nolichucky River system upstream at least to the South Toe River. A State Special Concern status is recommended. Field survey efforts should concentrate on appropriate habitat in Spring Creek, the lower French Broad River, and in the Nolichucky River system to ascertain the present status of this species.

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North Carolina's Imperiled Fish Fauna, Part II
Submitted by Wayne C. Starnes and Bryn H. Tracy
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's June and September 2010 newsletter, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the second of several planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare fishes.

"Atlantic" Highfin Carpsucker, *Carpoides* sp. cf. *velifer* (undescribed taxon)
Current Status: Special Concern, Proposed Status: Endangered

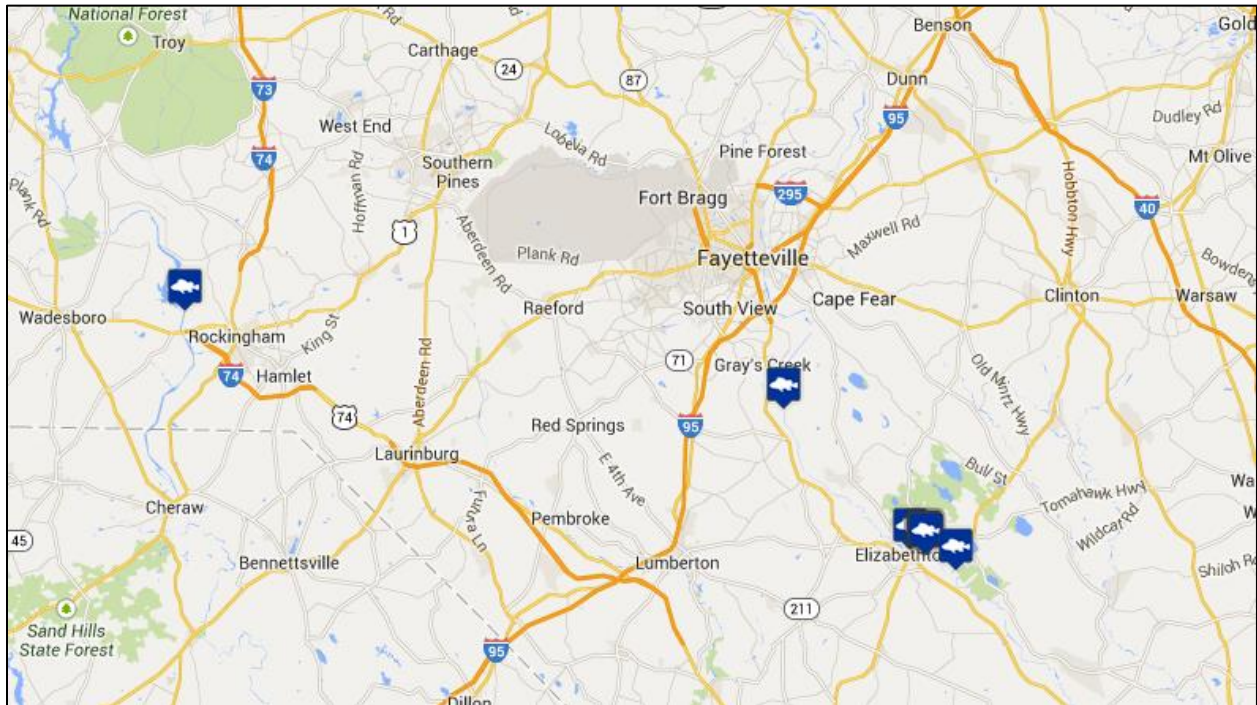


Photograph courtesy of Wayne C. Starnes.

Description – The Atlantic drainage form of this large thick-bodied sucker has only moderately elongated anterior rays on the dorsal fin (as opposed to Mississippi and eastern Gulf Coast drainage forms that have these rays extremely elongated). It can be differentiated from other thick-bodied suckers by a triangular subopercle that is widest below the middle, an open anterior fontanel, and a small fleshy knob at the tip of the lower lip. The tip of the lower jaw is nearly under the anterior nostril (well before it in other carpsucker species) and the snout is blunt and very rounded. Nuptial tubercles (tiny to medium-sized, usually pointed protuberances developed during the breeding season) cover the head except for the opercle and cheeks. Body color is dull gray to brown dorsally and silvery on the sides and ventrally; the fins are silvery and are often slightly tannish medially. Adults range in length from 225 to 500 mm total length (Rohde et al. 2009); the largest Atlantic drainage specimen in the collection of the North Carolina State Museum (NCSM) is slightly less than 450 mm total length.

Range – The Highfin Carpsucker (*C. velifer*) occurs in the Mississippi and lower Missouri drainages and in other Gulf of Mexico drainages from the Florida panhandle to Alabama (Lee and Platania 1980). The "Atlantic" Highfin Carpsucker is restricted to the Piedmont and Coastal Plain of North Carolina, South Carolina, and Georgia (Rohde et al. 2009). The only known North Carolina populations occur, or

occurred, in the Pee Dee River below Blewett Falls Reservoir (Anson-Richmond counties) and in the Cape Fear River between Lock and Dam No. 3 and Sugarloaf Landing (Bladen County) (Menhinick 1991; NCSM database queried 11/01/2010). In the Pee Dee drainage, the species was infrequently reported from Blewett Falls Lake in 1986 and in the river below the Blewett Falls Dam in Chesterfield County, SC in May 1977 (PE 2006). Only a single specimen from the Pee Dee River in North Carolina is vouchered at the NCSM (Catalogue No. 31697, collected June 20, 1956) despite intensive sampling of that river in recent years. Another specimen from the Pee Dee River in South Carolina is vouchered at Tulane University (Catalogue No. 175146, collected May 30, 1979). Unvouchered specimens and records are reported from the Catawba River chain-of-lakes (Menhinick 1991) and the species very likely formerly occupied the Santee River drainage in North Carolina based upon extant populations in South Carolina (Rohde et al. 2009). The record reported for “Mississippi” Highfin Carpsucker from Apalachia Lake in Cherokee County, NC (Messer 1966; Menhinick 1991) is considered questionable.



Distribution of the “Atlantic” Highfin Carpsucker in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of 15 records.

Habitat – The Highfin Carpsucker prefers clean water and firm substrate of larger streams and reservoirs and is much less tolerant of siltation and turbidity than other carpsuckers (Etnier and Starnes 1993; Pflieger 1975; Pflieger 1997). Although it prefers moderately deep water, the Highfin Carpsucker may also be found in shallow backwater areas. In the Santee and Savannah River drainages in South Carolina, the “Atlantic” Highfin Carpsucker occurs in rivers over sand and gravel with a moderate current (Rohde et al. 2009).

Life History and Ecology – Based on typical Highfin Carpsucker populations from the Mississippi River drainage, sexually mature fish migrate upstream to smaller tributaries and spawn in July-August over deep gravelly riffles (Pflieger 1975; Pflieger 1997). The “Atlantic” Highfin Carpsucker probably spawns earlier; in the Pee Dee River, a ripe male in spawning condition was collected in April 1999 from the tailwaters below Blewett Falls Dam (PE 2006). In the Escambia and Choctawhatchee rivers in Florida, males dominate the electrofishing catch in winter and spring; during the summer and fall females are predominate, as males may have moved downstream by that time (Beecher 1977). Total lengths of the

Highfin Carpsucker from the Illinois River in Oklahoma are approximately 210, 290, 310, 330, 360 mm for the first five years, respectively (Carlander 1969).

Rationale for Designation – Based on its previously described morphological distinctions and the hydrogeographic remoteness, from the Mississippi and Gulf Coast drainage Highfin Carpsucker, the “Atlantic” Highfin Carpsucker may represent an undescribed taxon. The distinctiveness of the “Atlantic” Highfin Carpsucker indicates they very likely do not represent introductions from Mississippi or Gulf Slope river basins. The Pee Dee River population may already be extirpated. The population and taxonomic status of the Cape Fear population is uncertain at this time (latest records from 1997) but is under investigation by staff from the NCWRC, NCSM, and Tulane University. It is hoped that targeted efforts will reveal the continued presence of a Cape Fear population and facilitate genetic investigations that will be taxonomically definitive. The limited distribution with no apparent potential for recolonization in either the Pee Dee or Cape Fear River drainages would indicate that State Endangered is the appropriate status for the species.

Recommendations -- Field survey efforts should concentrate on appropriate habitats in the Cape Fear River between Lock & Dam No. 3 and Sugarloaf Landing (Bladen County) and possibly areas upstream of Lock & Dam No. 3 (Cumberland-Harnett counties) where spawning may occur. Any specimens collected should be carefully documented and vouchered (and a fin clip tissue sample preserved in ethanol for DNA studies before preserving the specimen in formalin) with the NCSM.

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North Carolina's Imperiled Fish Fauna, Part III
Submitted by Bryn H. Tracy
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010 newsletters, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the third of several planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare fishes.

Tennessee Darter, *Etheostoma tennesseense* Powers & Mayden 2007
Current Status: State Special Concern, Proposed Status: Endangered



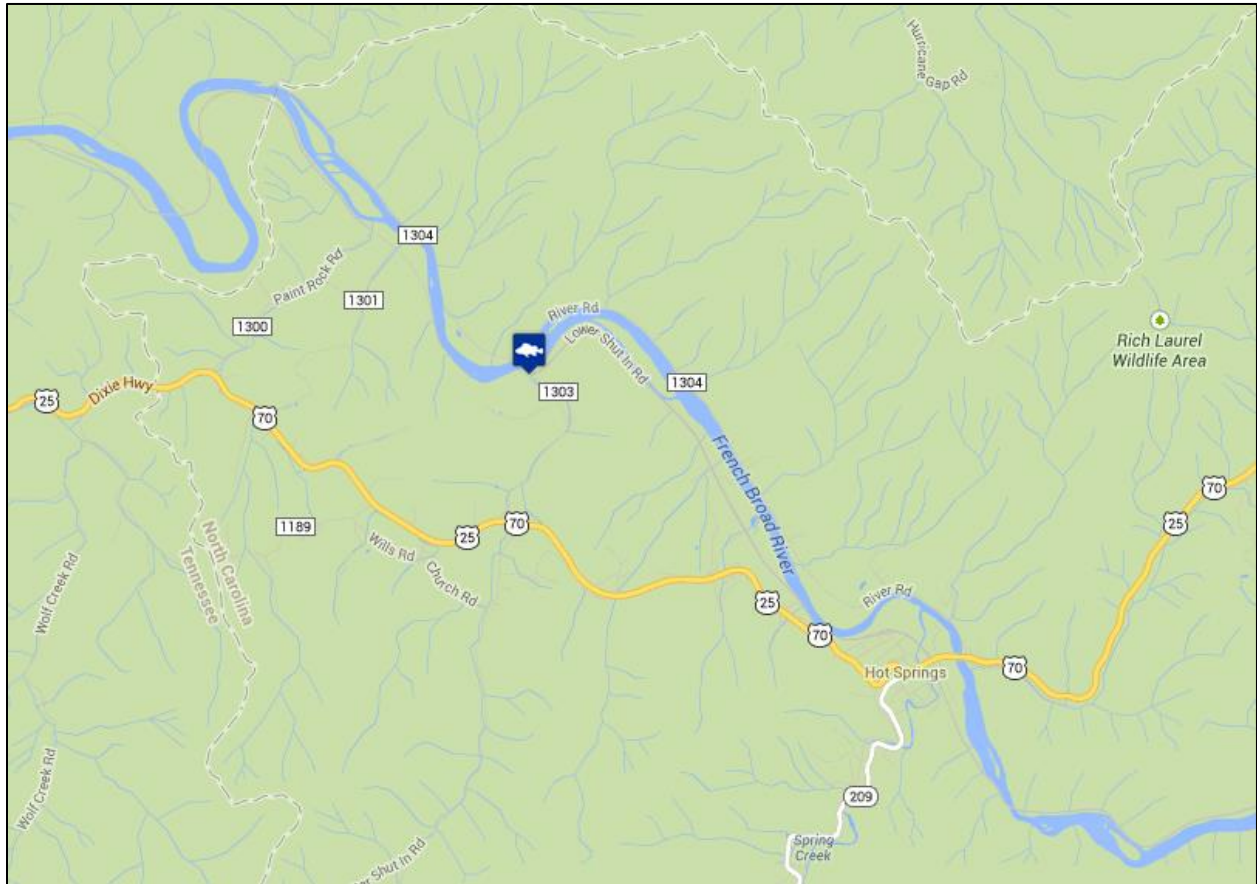
Photograph by Uland Thomas, courtesy of the North American Native Fishes Association and Southeastern Fishes Council (<http://ichthyology.usm.edu/sfc/index.php>)

Description – Recently distinguished from Tennessee Snubnose Darter, *Etheostoma simoterum* (Cope), by Powers and Mayden (2007), this small darter (up to 63 mm SL) has large fins and a very blunt, rounded snout. The opercle and cheek are at least partially scaled. The body is greenish above and yellowish below, with about 8 or 9 dark green, squarish blotches along each side, which may be confluent or partly so. Small red and yellow dorsal spots are sometimes present. Females and young are less colorful than males. The species differs from all members of the *E. simoterum* complex in nuptial males having the following combination of characters: orange breast, belly, and venter of caudal peduncle; blotches along lateral line olive green to black; and large bright red spots and horizontal banding or vermiculation generally lacking in most of the interradiation membranes of the spinous dorsal fin. See Powers and Mayden (2007) for more detailed information and for color photographs of the spinous dorsal fin and lateral and ventral views of nuptial males.

Range – The Tennessee Darter inhabits the Clinch and Powell rivers and Holston River and its tributaries downstream of the forks of the Holston and all tributaries of the Tennessee River downstream to the Hardin Creek system in Hardin and Wayne counties, Tennessee. It also inhabits the upper Bluestone River of the New River drainage of the upper Ohio River. It is present in the French Broad, Pigeon, Little Tennessee, and Hiwassee River systems, but is largely absent from the Blue Ridge, portions of these systems, as well as the north-flowing tributaries of the southern bend of the Tennessee River in north Alabama (Powers and Mayden 2007).

In North Carolina, there is one early record, as *Hyostoma simoterum* Cope, of a 3 inch long specimen collected by E. D. Cope in the fall of 1869 from an unspecified locality on the French Broad River (Cope 1870, page 494). According to Smith (1907; pages 258-259) the specimen was vouchered at the U. S. National Museum; it was catalogued in the original ledger under USNM 14982 (L. Palmer, Smithsonian Institution, pers. com. November 2009). However, an online electronic search of the National Museum of Natural History's collection (http://vertebrates.si.edu/fishes/fishes_collections.html) failed to locate this specimen. In November 2009, L. Palmer also could not find the specimen in the collection under its original name, *Hyostoma simoterum*, or under *Etheostoma simoterum* or *Diplesion simoterum* and the specimen is presumed lost.

There are two questionable records from Spring and Laurel creeks in Madison County (Etnier 1980, Menhinick 1986). The origin of these records is uncertain (D. A. Etnier and E. F. Menhinick, pers. com.) and they should be disregarded until any vouchers that may exist are found. In August 2009, W. C. Starnes and B. H. Tracy collected two specimens from Shut-in Creek in Madison County. These specimens were vouchered at the North Carolina State Museum (Catalogue No. 55217) and represent the first verifiable record of this species for the state since 1869 and the only recent record currently represented by vouchers.



Distribution of the Tennessee Darter in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of one record.

Habitat – The Tennessee Darter inhabits small to large streams over primarily gravel, cobble, and boulder substrates adjacent to riffles (Powers and Mayden 2007). The two specimens collected by Starnes and Tracy were found in a clear, shallow, gravel and sand bottom run/pool.

Life History and Ecology – No formal study of the ecology of the Tennessee Darter has been published (Powers and Mayden 2007). However, traits for the *E. simoterum* species complex were summarized in Etnier and Starnes (1993) and Jenkins and Burkhead (1994). Peak spawning probably occurs from April through early May with females producing as many as 250 eggs per year. Life span is probably at most two years. Like other species in the *E. simoterum* complex, *E. tennesseense* probably feeds on small aquatic insects such as midge larvae, mayfly nymphs, caddisfly larvae, microcrustaceans, amphipods, water mites, fingernail clams, and snails (Etnier and Starnes 1993; Jenkins and Burkhead 1994).

Rationale for Designation – Currently the species is known from one stream in North Carolina. It previously was considered as possibly extirpated from the state and later as Special Concern. The presence of a very small localized population in a single tributary to the French Broad River near the Town of Hot Springs warrants a designation of State Endangered.

Recommendations -- The species is extremely abundant and successful in eastern and south-central Tennessee and extreme north-central Alabama (Etnier and Starnes 1993; Powers and Mayden 2007). The unusual distribution of the Tennessee Darter, stopping just inside the North Carolina boundary, perhaps in association with the abrupt gradient change and/or transition to Blue Ridge habitat at this boundary, permits some interesting studies on habitat selection and tolerance. Appropriate French Broad River tributary streams near the Tennessee state line in Madison County should be surveyed to ascertain the present status of this species. Reintroduction into the lower stretches of the French Broad River drainage should be considered if a suitable combinations of habitat and water quality can be located.

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North Carolina's Imperiled Fish Fauna, Part IV
Submitted by Bryn H. Tracy
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010 and 2011 newsletters, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the fourth of several planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare fishes.

Roanoke Logperch, *Percina rex* (Jordan and Evermann 1889)
Current Status: Not Listed, Proposed Status: Endangered



Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Virginia Division of Game & Inland Fisheries and Southeastern Fishes Council (<http://ichthyology.usm.edu/sfc/index.php>).

Description – Described by Jordan and Evermann from specimens taken in swift water in the Roanoke River near Roanoke, VA in 1888 (Jordan 1889). A large darter with round or vertically elongate lateral blotches, back with dark vermiculations, most fins strongly patterned, and snout moderate or long, conic or pig-like (Jenkins and Burkhead 1994). Adults are ~80-125 mm standard length (Jenkins and Burkhead 1994); maximum total length is to at least 165 mm (Roberts and Rosenberger 2008).

Range – Previously known only from the Roanoke River drainage in Virginia where it is restricted to the Chowan, Dan, and Roanoke rivers in the Piedmont and Ridge and Valley provinces (Jenkins, *et al.* 1980; Jenkins and Burkhead 1994). It has been found in larger streams in the upper Roanoke, Smith, Pigg, Otter, and Nottoway river systems and Goose Creek, separated by long river gaps and large reservoirs (Roberts and Rosenberger 2008). The species was not listed as occurring in North Carolina by Menhinick, *et al.* (1974). A key to the species of *Percina* and a distribution map showing a locality nearby in Virginia were provided in Menhinick (1991). The species was not reported from the Dan River system in Virginia or North Carolina by Rohde, *et al.* (2003).

First discovered in 2007 in North Carolina (NCWRC 2008), known populations are restricted to the upper Dan River system and three, possibly four, of its tributaries in Rockingham County. The North Carolina collections have been summarized by Wood (2009) and Wood and Nichols (2009; 2010) (Table 1). The first specimen from the state, a young-of-year (as determined from Rosenberger 2007), was collected in July 2007 by Duke Energy biologists from the Dan River downstream of its confluence with the Smith

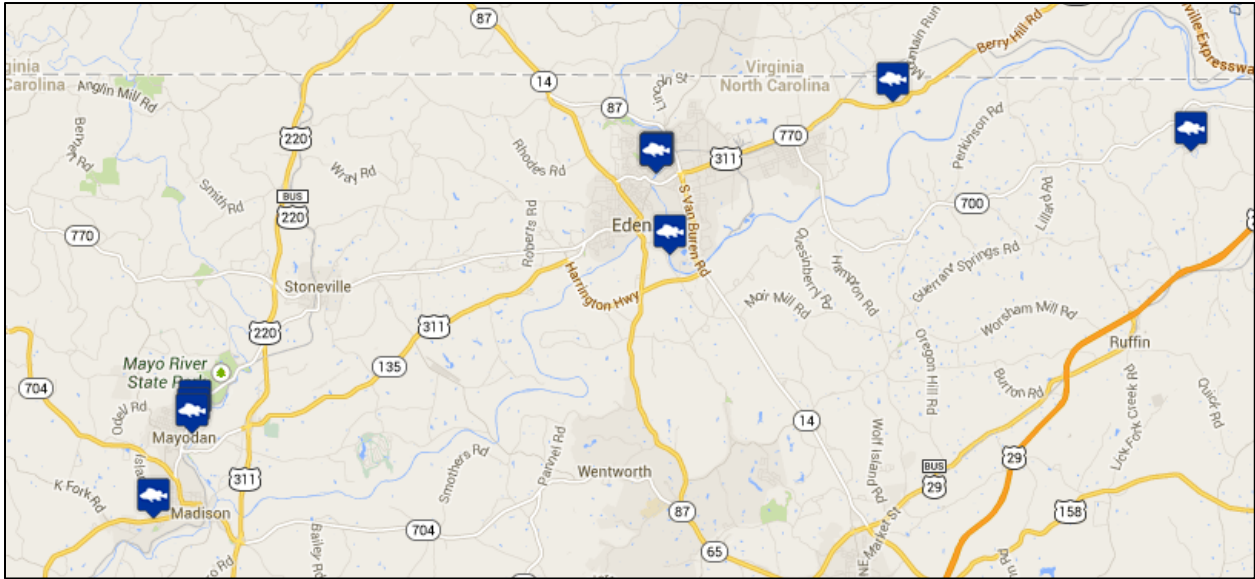
River. Initially believed to be a waif from the Smith River population in Virginia, a second fish, an adult, was collected from the Smith River proper in September 2007 by staff of the North Carolina Wildlife Resources Commission (NCWRC) and North Carolina State Museum of Natural Sciences (NCSM). A much larger reproducing population consisting of juveniles and adults was documented by NCWRC, NCSM, and Division of Water Quality (DWQ) staff in the Smith River in August 2008 (NCWRC 2008). An unknown population was then discovered by NCWRC staff in the Mayo River in July 2008, the first known occurrence in that subsystem in either North Carolina or Virginia. Since then, an individual was found by DWQ staff in Big Beaver Island Creek and additional fish in the Smith and Mayo rivers by NCWRC and Appalachian State University staff (Table 1). Fish in the Mayo and Smith rivers are found below small mill dams creating short reaches of improved water quality and cleaner substrates (Wood and Nichols 2010).

Table 1. Collection records for the Roanoke Logperch in North Carolina. All localities are in Rockingham County and all specimens vouchered are at the North Carolina State Museum of Natural Sciences (NCSM).

Date of Collection	Waterbody	Location	No. Collected	Total Length (mm)	NCSM No.	No. Specimens Vouchered	No. Fish Fin-Clipped
07/24/2007	Dan R	Near SR 2039	1	47	NCSM 46044	1	0
09/12/2007	Smith R	Near NC 700/770 ¹	1	130	NCSM 46804	1	1
07/29/2008	Mayo R	Near NC 135 ²	3	110, 112, 113	NCSM 50086	1	3
08/18/2008	Smith R	Near NC 700/770 ¹	10	68, 115, 118, 127, 131, 135, 136, 150, 151, 159	NCSM 50085	3	7
05/14/2009	Big Beaver Island Cr	US 311	1	110	NCSM 60926	1	0
08/03/2009	Smith R	Near NC 700/770 ¹	2	140, unknown	---	0	0
09/04/2010	Mayo R	Near NC 135 ²	2	137, 143	NCSM 60931 & 60932	0	2
Totals			20			7	13

¹between Spray Cotton Mill dam and NC 700/770

²between Washington Mill dam and NC 135



Distribution of the Roanoke Logperch in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of 10 records.

Collectively, the 20 North Carolina fish may represent one previously unknown, but greater Dan River population (Wood and Nichols 2009). However, the absence of Roanoke Logperch from numerous prior collections in this area may suggest colonization, or recolonization, from source populations in Virginia via Smith River has occurred. Duke Energy biologists have been consistently sampling the Dan River twice a year for the past 20 years. The single young-of-year collected in 2007 occurred during a severe drought when good probable upstream habitats were of minimal size or non-existent. Exceptional water clarity may have also aided capture in what is normally a very turbid river. A strong possibility also exists that populations formerly occurred in North Carolina portions of the Dan River system and were possibly extirpated or reduced to undetectable levels during past times of diminished water quality, since improved. Results of recent genetic studies (below) are indicative of some uniqueness in lower Smith/Mayo rivers samples, including from populations in the upper Smith River in Virginia. Whether these differences are the result of a founder effect attendant to a recent colonization or, conversely, a genetic bottleneck experienced by a resident but extremely diminished population is unclear at this time.

Habitat – The Roanoke Logperch is extremely sensitive to environmental degradation (Jenkins and Burkhead 1994). Inhabiting medium-sized, warm, and usually clear streams, it occupies riffles, runs, and pools with sandy to boulder-strewn bottoms (Jenkins, *et al.* 1980) (Figure 2). As a benthic dweller, all life stages avoid moderately and heavily silted microhabitats, except during winter periods of inactivity (Jenkins and Burkhead 1994; Roberts & Rosenberger 2008). Over the course of a year, adults inhabit areas ranging from swift gravel and rubble riffles and complex bedrock shoals, to slow sandy pools. Age 0 fish often occur in mixed species schools in shallow, sand-gravel pool margins and back waters (Roberts and Rosenberg 2008; Roberts, *et al.* 2010). When water temperature falls below 8°C, individuals hide under rocks and become quiescent (Jenkins and Burkhead 1994).



Figure 1. The Smith River upstream of NC 700/770, Rockingham County, NC, August 18, 2008.

Life History and Ecology – A benthic insectivore that uses its snout to overturn loosely embedded gravel to feed on aquatic insects, primarily chironomids and caddisflies (Jenkins and Burkhead 1994). In the upper Roanoke River, many fish mature at 2-3 years old and by Age 4 all fish are mature. Longevity is up to 6.5 years (Jenkins, *et al.* 1980; Jenkins and Burkhead 1994). Based on gonadal development, peak spawning in the upper Roanoke River probably occurs during April-May in deep runs where the eggs are buried in gravel (Roberts & Rosenberger 2008). The spawning season for other populations are unknown and may vary depending on thermal and flow regimes (Rosenberger 2007). As in many species of *Percina*, larval drift is probably important in dispersal and recolonization of downstream sites. In the upper Roanoke River, juveniles may disperse up to 50 km with a mean dispersal of 4 km over the lifetime of a fish (Roberts, *et al.* 2010). Extensive dispersion of spawning effort and/or juveniles appears to promote genetic panmixia over large distances and may enhance fitness and dampen population fluctuation in variable riverine environments (Roberts, *et al.* 2010).

Rationale for Designation – The Roanoke Logperch is a federally endangered species (Moser 1989) and is being added for the first time to the North Carolina listing of jeopardized freshwater fishes. All native or resident wild animals which are on the federal lists of endangered or threatened species pursuant to the Endangered Species Act have the same status on the North Carolina protected animal lists (North Carolina General Statute §113-334(a)). Preliminary genetic testing at VPI&SU of fin clipped specimens suggests that the North Carolina population inhabiting the greater Dan River subsystem is genetically unique from the known populations in Virginia (Wood and Nichols 2009; Roberts, *et al.* 2009). The significance of these findings is still being evaluated.

Threats to Roanoke Logperch populations in Virginia include siltation and hydrologic alteration from urbanization, channelization, water withdrawal, siltation from agriculture and forestry, catastrophic chemical and sewage spills, and disrupted gene flow and habitat loss from reservoir construction (Roberts and Rosenberger 2008). In May 2009, a fish kill resulting from a deliberate illegal discharge occurred in the Virginia portion of Cascade Creek, a tributary to the Dan River whose confluence is east of the Town of Draper in Rockingham County. A here-to-fore unknown population of Roanoke Logperch were found as a result of the fish kill to inhabit the creek in Virginia. Staff with the Virginia Department of Environmental Quality found two dead Roanoke Logperch just upstream of the state line. Due to the large extent of the fish kill, staff expected that there were possibly more deceased Roanoke Logperch downstream in North Carolina. NCWRC staff then investigated the North Carolina portion of the creek and found no evidence of the fish kill. During the summer NCWRC staff backpack electrofished a large portion of the creek and found a diverse fish community, but no Roanoke Logperch (R. Nichols, pers. com., November 2011). In North Carolina, small dams may also prevent upstream migrations to previously inhabited reaches and may isolate the populations from the larger populations in Virginia.

Recommendations -- North Carolina water quality classifications and standards in the upper Dan River system should be strengthened and enforced. The North Carolina Division of Water Quality, working in cooperation with the NCWRC and the U.S. Fish & Wildlife Service, should be encouraged to develop site-specific management strategies to sustain and recover federally-listed species as described in 15A NCAC 02B.0110 of the North Carolina Administrative Code (NCAC 2007).

Field survey efforts should concentrate on appropriate habitats in the mainstem Dan River and its larger tributaries in Stokes and Rockingham counties, including Cascade Creek. Watershed-level, coordinated efforts need to inventory threats, minimize siltation, prevent spills and enhance population connectivity (Roberts and Rosenberger 2008). Field surveys have been conducted in the upper Dan River system and Mayo River subsystem in 2009 and 2010, but no additional specimens were found (R. Nichols, pers. com., November 2010). The Meherrin River subsystem of the Chowan River in Northampton County should also be surveyed, because there might be yet an undetected population of Roanoke Logperch in this river (R. Nichols, pers. com., November 2010).

Translocations of populations should be considered along with dam removal, when ecologically feasible and beneficial to the entire aquatic community, on the Mayo and Dan rivers in Rockingham and Stokes counties to restore free-flowing reaches of the rivers and allow upstream expansion of existing known populations and restore connectivity between populations (Wood and Nichols 2010).

Literature Cited and Recommended Readings

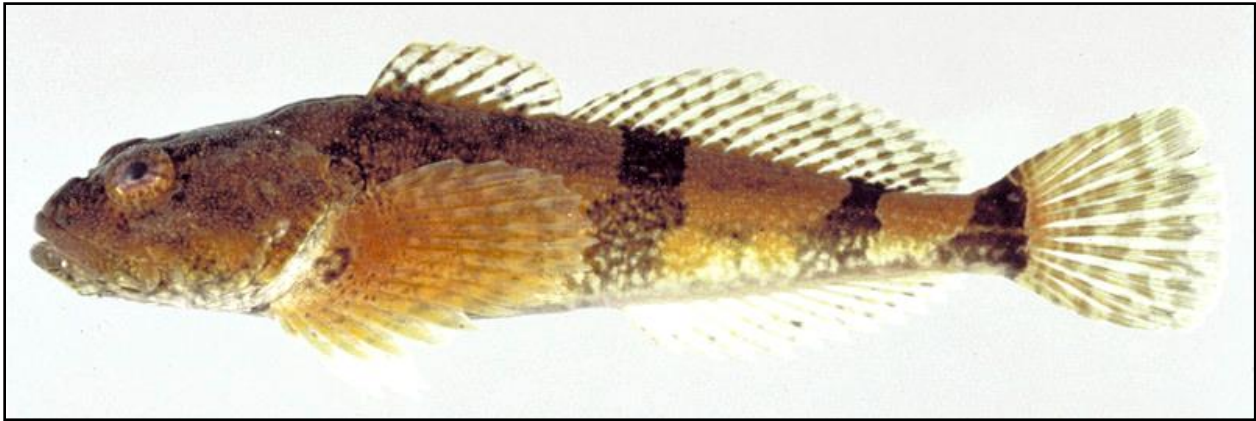
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North Carolina's Imperiled Fish Fauna, Part V
Submitted by Bryn H. Tracy and Wayne C. Starnes
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010 and 2011 newsletters, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22) (Harris et al 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the fifth of several planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Banded Sculpin, *Cottus carolinae* (Gill 1861)
Current Status: Threatened, Proposed Status: Endangered



Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Virginia Division of Game and Inland Fisheries and Southeastern Fishes Council (<http://ichthyology.usm.edu/sfc/index.php>).

Description – Banded Sculpin range in size up to 175 mm total length. The ground color is most often rusty brown with four dark dorsal saddles, at least the posterior three of which are typically distinct. The color of the body is variable depending on substrate and water clarity. Banded Sculpins can easily be confused with North Carolina forms of the *C. bairdii* (Mottled Sculpin) species complex, which occur widely in mountain streams of North Carolina; they differ in that the Banded Sculpin has modally 16 or 17 pectoral fin rays (15 in *C. bairdii*) and does not have a contrasting red marginal and black basal band in the spinous dorsal fin (Etnier and Starnes 1993). The upper preopercular spine is prominent and "sickle" shaped versus a simple, broadly pointed spine in Mottled Sculpin.

Range – The Banded Sculpin complex is widespread and common throughout the Ozark region; the Tennessee and Cumberland river drainages; the Mobile Basin both above and, less commonly, below the Fall Line; and the Ohio River drainage from its mouth to its southern headwaters (New River system), but is absent from much of the northern portion of the Ohio drainage. The Banded Sculpin occurs throughout eastern Tennessee (Lee 1980; Etnier and Starnes 1993). Harned (1979) collected it very close to North Carolina in the French Broad River in Tennessee.

Historical North Carolina records are from the French Broad River system, Madison County (Cope 1870; Robins 1954). The 12 specimens collected by Cope in 1869 from the French Broad River at the Town of Hot Springs in Madison County and vouchered at the Academy of Natural Sciences of Philadelphia (Catalogue Nos. ANSP Catalogue Nos. 11838-11849) bear Cope's original label: "French Broad River, N.C" (Figure 1). However, another label says: "*Cottus carolinae*, confirmed by D. A. Neely, 2006, from

North Carolina: Henderson Co.: French Broad River: E. D. Cope" (M. Sabaj Perez, ANSP pers. com., June 2009).

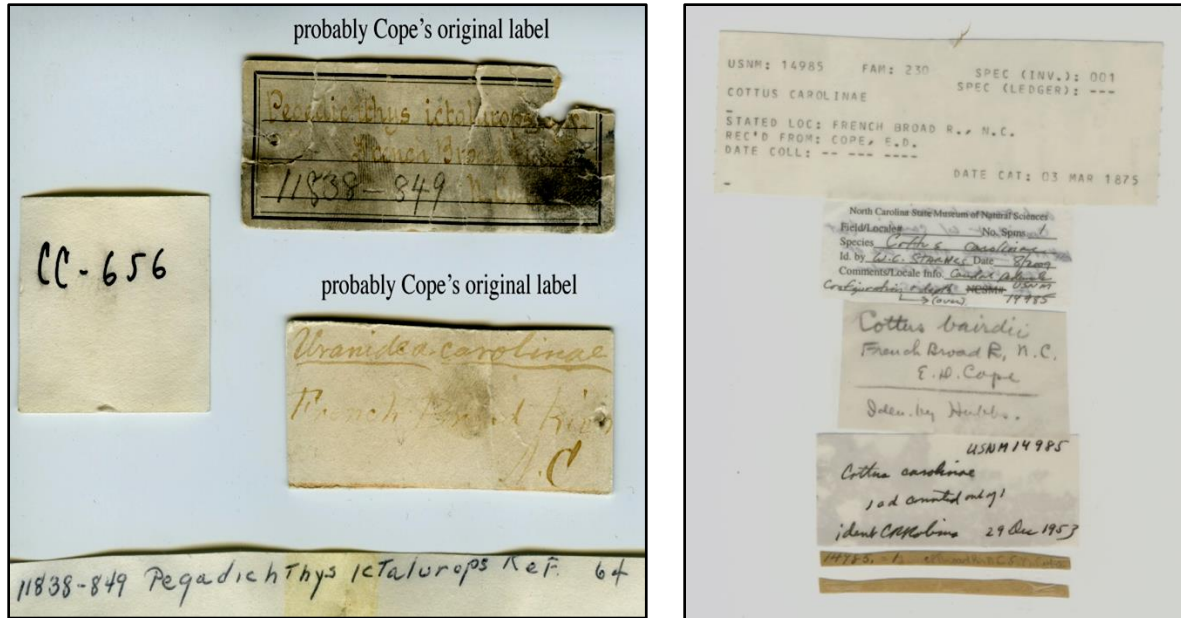


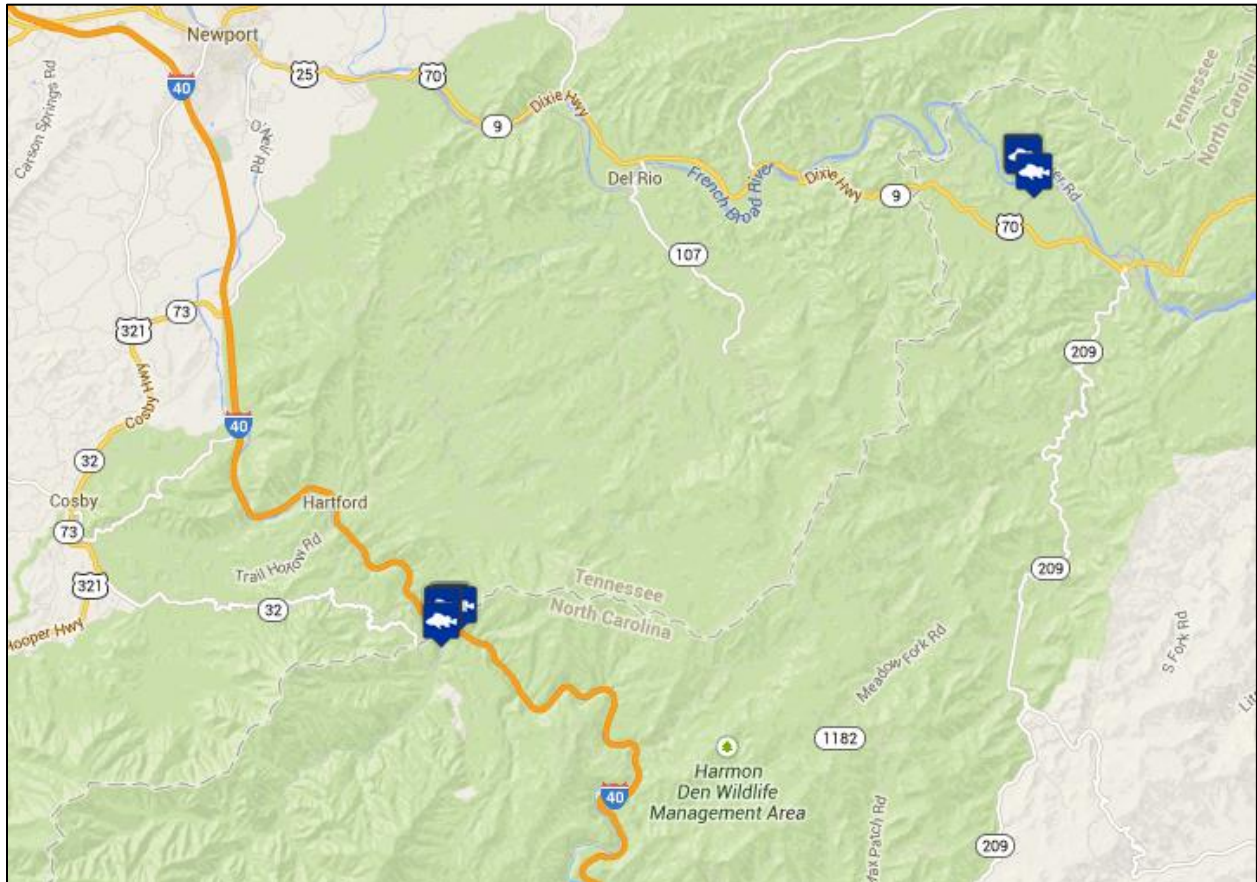
Figure 1. Labels of *Cottus caroliniae* specimens at the Academy of Natural Sciences of Philadelphia (left) and at the National Museum of Natural History (right). Photographs courtesy of Mark Sabaj-Perez (ANSP) and Lisa Palmer (USNM).

There is a single specimen of *Cottus caroliniae* collected by Cope from the French Broad River, North Carolina and vouchered at the National Museum of Natural History (catalogued [Figure 1] on March 03, 1875, USNM Catalogue No. 14985), but no precise date of collection prior to 1875 or more precise locality information are known. The specimen is likely an exchange specimen from Cope's original lot at ANSP, a common practice in those days. Since then, the specimen has been identified as *C. bairdii* by Hubbs (date unknown), as *C. caroliniae* by Robins in 1953 and correctly plotted in Robins (1954), and as *C. caroliniae* by Starnes in 2009 (Figure 1). Cope (1870) stated that the species was abundant in the French Broad River, Madison County, North Carolina, but nowhere did he mention the species as occurring upstream in Henderson County, even though Cope collected in Henderson County in the fall of 1869. In the fall of 2009, W. C. Starnes and B. H. Tracy concluded that a sorting or mislabeling error of Cope's specimens had subsequently occurred, creating the misleading distributional picture. Despite extensive collections being made in the French Broad River basin in North Carolina since 1869, there is no evidence that Banded Sculpin were ever found far upstream from the Town of Hot Springs.

Lee (1980) shows records from the Nolichucky River and Watauga River systems, but those records are unverifiable. Other records from Big Laurel and Spring creeks in Madison County were incorrectly attributed to Robins (1954) by Menhinick (1987), Menhinick (1991), Menhinick and Braswell (1997), and Rohde et al. (1998).

Menhinick reported collecting 10 specimens in 1994 (confirmed by W. C. Starnes, August 2009) from Shut-in Creek near Hot Springs (Rohde et al. 1998). In August 2009, a re-examination by North Carolina State Museum (NCSM) staff of two specimens collected and vouchered as part of NCWRC's 1963 survey of the Pigeon River and tributaries (Messer 1964) confirmed the presence of Banded Sculpin in Big Creek in Haywood County (NCSM Catalogue No. 55213) (Starnes and Hogue 2011). In August 2009, Starnes and Tracy collected Banded Sculpin from two sites on Shut-in Creek and from the French Broad River near the mouth of Shut-in Creek downstream from the Town of Hot Springs (NCSM 55216, 55220, and 55218, respectively). Unbeknownst to them, biologists with TVA had previously collected 27 specimens of Banded Sculpin from a site further upstream on Shut-in Creek in March 1999, May 2004, and June

2009 (NCWRC database, S. Fraley, pers. com.). In October 2009 and 2010, Tracy also collected Banded Sculpin again from Big Creek, just upstream from its confluence with the Pigeon River in Haywood County (NCSM 55097; NCSM 62237) and in October 2010 from the Pigeon River just upstream of Progress Energy's powerhouse in the bypass reach (NCSM 62241). A collection in 1988 of the Mottled Sculpin, *C. bairdii* species complex, by Progress Energy biologists from the Pigeon River bypass near Big Creek at the state line was reported in Starnes and Hogue (2011). However, based upon a recent examination of the eight specimens by Starnes and Tracy, the specimens were re-identified as Banded Sculpin and were collected in 1987 not in 1988. Another eight specimens collected by Progress Energy biologists from Big Creek in in 1989 were also re-identified as Banded Sculpin.



Distribution of the Banded Sculpin in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of 17 records.

Habitat – This species occurs in riffle areas from tiny spring runs to large rivers (Figure 2). Where *C. caroliniae* and *C. bairdii* occur in the same stream, *C. caroliniae* typically occurs in the more downstream areas, but broad areas of sympatry (overlapping ranges) often occur. In Big Creek, a medium-size turbulent and clear creek that drains the northeast corner of the Great Smoky Mountains National Park, the species is found amongst boulders and cobbles in swift riffles and chutes (Figure 2). Similarly in Shut-in Creek, the species is found in riffles and runs.



Figure 2. Habitats of the Banded Sculpin: Big Creek at SR 1332 (left) (October 2010) and the Pigeon River off I-40, just upstream of Progress Energy's Walters Hydroelectric Plant (October 2004), Haywood County, NC. The Pigeon River photograph is courtesy of Rick Smith, Progress Energy.

Life History and Ecology – Banded Sculpins breed during winter and early spring, with the male defending a nest site under a stone or other object. In Kentucky, females produced about 475 eggs per year, and in these populations total lengths of 50 to 80, 100 to 130, and over 160 mm were reached at ages 1, 2, and 3, respectively; maximum life span is probably four years (Craddock 1965). They are voracious predators, feeding as adults on large aquatic insects, small fishes (especially darters), salamanders, and crayfish (Small 1975, Starnes 1977).

Rationale for Designation – Intensive collections in 2007 as part of the French Broad River basinwide assessment for priority species identified in the NCWRC's Wildlife Action Plan did not detect the species in Big Laurel or Spring creeks (S. Fraley, pers. com.). Mottled Sculpin are found in the Big Laurel Creek watershed (e.g., Shelton Laurel and Little Laurel creeks), but surprisingly, no species of sculpin are found in the Spring Creek watershed, despite having habitats, flows, and a temperature regime ideally suited to these cold-cool water species. In the Pigeon River watershed in Haywood County, sculpins are found upstream of Canton, but, for reasons unknown, are seemingly absent from the major tributaries downstream (e.g., Richland, Jonathans, Crabtree, Fines, Cataloochee, and Cold Springs creeks). Because of a reduction of its distribution, coupled with two small and disjunct populations in Madison and Haywood counties, suggests a high protection status, State Endangered, should be assigned for this species.

Recommendations -- North Carolina water quality classifications and standards in the lower French Broad River and Nolichucky River systems should be strengthened and enforced. Coincidentally, the Big Laurel and Spring Creek watersheds were afforded supplemental water quality classifications by the NC Division of Water Quality as High Quality Waters and Outstanding Resource Waters (ORW), respectively in 2009; Shut-in Creek was also recommended for reclassification to ORW in 2010. Continued field survey efforts should concentrate on appropriate habitats in the mainstem lower French Broad River and its larger tributaries in Madison County and in tributaries to the lower Pigeon River within the Pigeon River gorge (e.g., Cataloochee Creek) in Haywood County.

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North Carolina's Imperiled Fish Fauna, Part VI
Submitted by Bryn H. Tracy and Wayne C. Starnes
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010 and 2011 newsletters, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 6th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Mountain Madtom, *Noturus eleutherus* Jordan 1877
Current Status: Special Concern, Proposed Status: Endangered



Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Virginia Polytechnic Institute and State University (<http://www.cnr.vt.edu/efish/>).

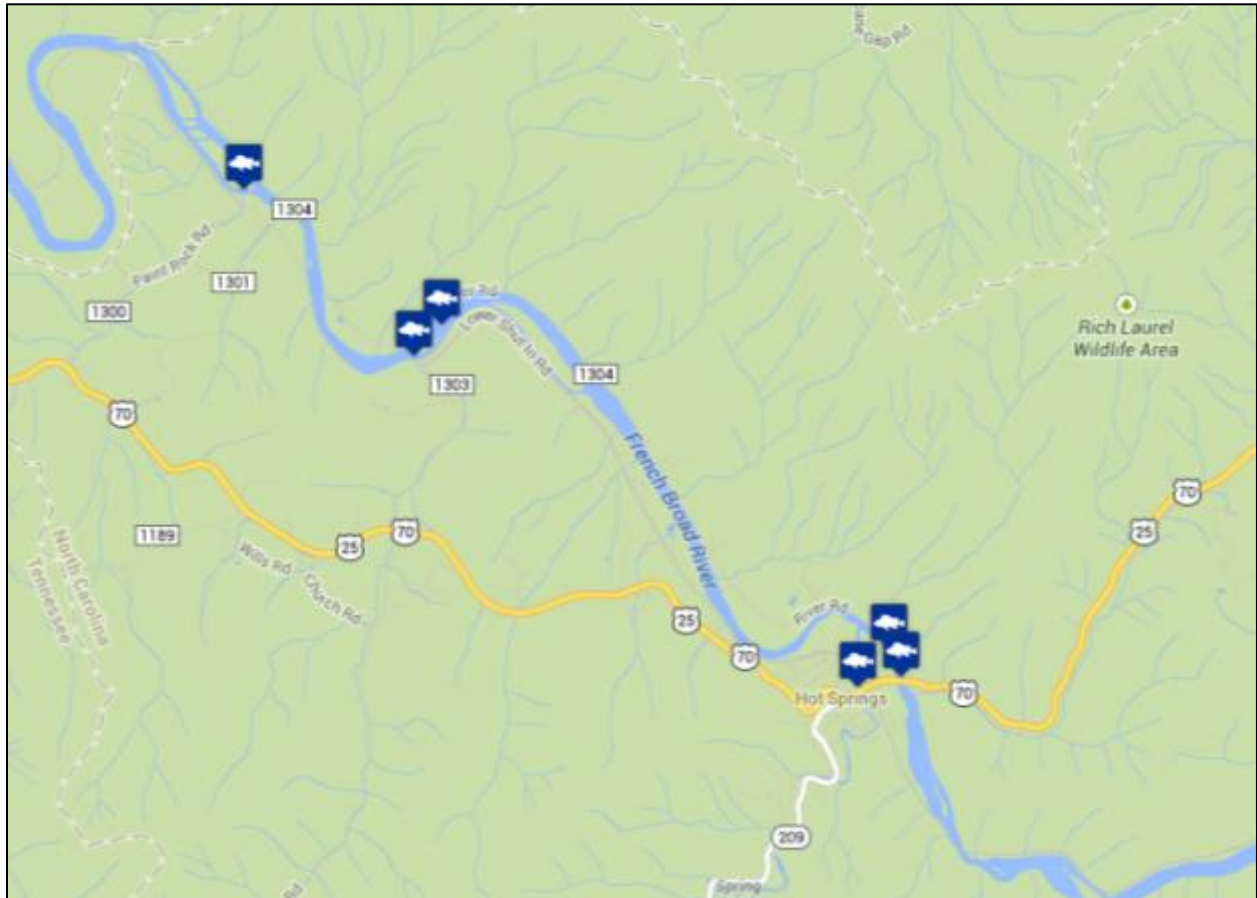
Type Specimen and Type Locality -- The Mountain Madtom was described by Jordan (1877) as a new species based upon a single specimen, about four inches long, that he and C. H. Gilbert had taken, alive, from the jaws of a Northern Water Snake (*Nerodia sipedon*). Jordan (1877) noted that it was similar to a young Flathead Catfish in form, coloration, and general appearance. The holotype specimen is at the National Museum of Natural History (i.e., the Smithsonian Institution, USNM Catalog No. 29678). The type locality is the (Big) Pigeon River, a rather clear tributary to the French Broad River at the Town of Newport (formerly known as Clifton), Cocke County, TN (Jordan and Brayton 1878).

Description – The Mountain Madtom is a small, weakly mottled catfish attaining a standard length (SL) of approximately 75 mm. In Tennessee, maximum size of the species is 85 mm total length. The body is short and stocky; the adipose fin, with its wide pale margin, is nearly free posteriorly, the dark pigment in the fin forms a horizontal bar along its base; and a midcaudal crescent-shaped blotch is lacking from the caudal fin. There are usually 43 to 49 caudal fin rays, 6 to 8 long recurved serrae on the posterior edge of the pectoral spine, and faint dorsal saddles. More detailed descriptions may be found in Taylor (1969); Etnier and Starnes (1993); and Jenkins and Burkhead (1994).

Range – The Mountain Madtom occurs in the Ohio River basin from western Pennsylvania through Ohio and Kentucky to the Wabash River drainage of Indiana and Illinois and the Cumberland River drainage, Tennessee. It is also found in the Tennessee River drainage of Tennessee, Virginia, North Carolina, and Georgia and in the lower Mississippi River basin, including the Mississippi River mainstem, and the Red,

Ouachita, White, and St. Francis River drainages of Oklahoma, Arkansas, and Missouri (Taylor 1969; Rohde 1980). In Tennessee, the Mountain Madtom is locally common in free flowing rivers of the Ridge and Valley and Highland Rim (Etnier and Starnes 1993).

Until 2007, the lone North Carolina record (one young specimen) was from Spring Creek at the Town of Hot Springs in Madison County collected in 1888 (Jordan 1889). Like the holotype, the specimen was also vouchered at the National Museum of Natural History (USNM No. 40405) and subsequently studied by Taylor (1969). In 1977, a Mountain Madtom was taken from the French Broad River near Bridgeport, TN more than 20 miles below the North Carolina state line (Harned 1979). In 2007, an individual was collected (by NCWRC staff -- S. J. Fraley, P. E. Pittman, W. T. Russ, J. C. Younce, and D. L. Yow) from the French Broad River at the Town of Hot Springs and vouchered with the North Carolina State Museum of Natural Sciences (NCSM No. 52482). Previous to that, the species was believed to be extirpated from North Carolina (Menhinick 1986; Menhinick and Braswell 1997; Rohde, et al. 1998). In 2009, 4 juveniles and 1 adult of the species were collected by the authors from three localities in Madison County -- the French Broad River near the mouth of Shut-in Creek, the French Broad River near the mouth of Grass Creek, and Spring Creek at the Town of Hot Springs (NCSM Nos. 55219, 55221, and 55210, respectively). In 2010 and 2011, the species appears to have become relatively more numerous in the French Broad River downstream from the US 25/70 bridge at Hot Springs to the state line (pers. com. S. J. Fraley and W. T. Russ; personal observations B. H. Tracy).



Distribution of the Mountain Madtom in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of six records.

Habitat – The Mountain Madtom occurs frequently in, above, and below clean-swept riffles and shoals of clear, large, swift streams and rivers over a cobble, pebble, and gravel bottom (Figure 1). Young-of-year

are often found in shallow riffles. In big rivers such as the Ohio and Mississippi, it also occurs in swift water around debris piles. In the French Broad River, it appears to be associated with swift riffles and shoals, a substrate of cobble, boulder, and bedrock, and the aquatic macrophytes *Podostemum ceratophyllum* (Hornleaf riverweed) and *Elodea canadensis* (Canadian waterweed), especially during low flow periods in the Fall.

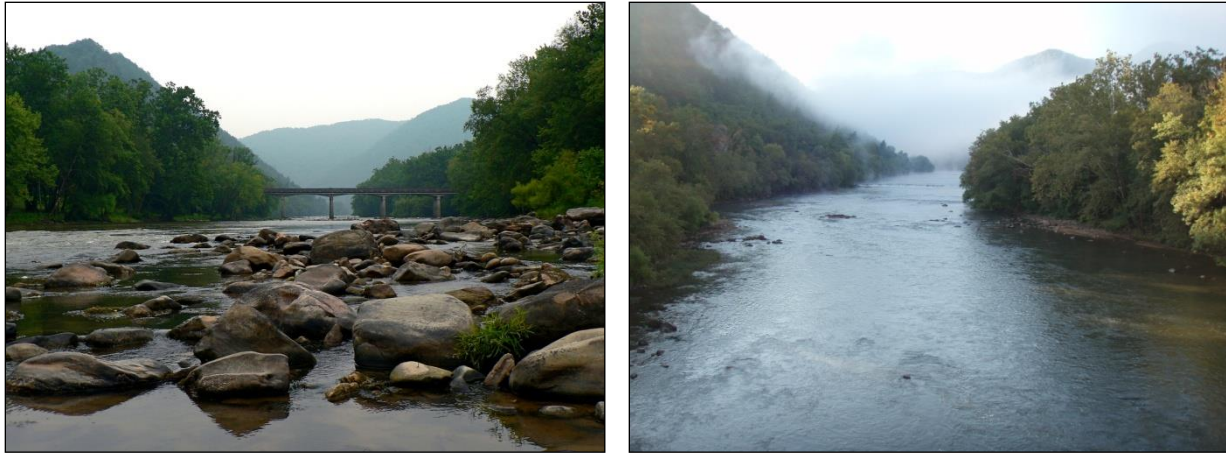


Figure 1. Habitats of the Mountain Madtom: French Broad River at Hot Springs, Madison County, NC. Photograph on the left is courtesy of www.ashevilleguidebook.com.

Life History and Ecology – A life history study of the Mountain Madtom, conducted in the Little and Nolichucky rivers, TN, revealed that the species lives a maximum of 4 years; growth of males and females is similar; males live longer than females; and males attain greater lengths (Starnes and Starnes 1985). The sex ratio is about 1:1 and spawning apparently occurs in June and July. Starnes and Starnes (1985) found one nest on 2 July in water 24°C in a shaded pool 0.7 m deep under an elliptical rock. The nest contained 70 embryos (eggs) guarded by a 66 mm SL male. The number of mature oocytes ranged from 55 to 115 in 21 females ranging from 41 to 59 mm SL. This species feeds most intensely after sunset on a variety of aquatic insects; feeding occurs chiefly in riffles.

Rationale for Designation – Menhinick and Braswell (1997) speculated that, with improved water quality of the French Broad River, the Mountain Madtom could return to North Carolina. Because the species is found downstream in Tennessee, reintroductions would not be warranted as long as recruitment from downstream reaches was possible. It seems that this may be the case with this species as water quality has improved in the river compared to what it was years ago. However, the presence of a very small localized population in the French Broad River and Spring Creek at the Town of Hot Springs in Madison County warrants a designation of State Endangered. The Spring Creek watershed was recently afforded supplemental water quality classification by the Division of Water Quality as Outstanding Resource Waters which should aid in the recovery of this species.

Recommendations Field survey efforts should concentrate on appropriate habitat in the lower French Broad River and its tributaries to ascertain the present status of this species in North Carolina waters.

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North Carolina's Imperiled Fish Fauna, Part VII
Submitted by Bryn H. Tracy, Wayne C. Starnes, and Stephen J. Fraley
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010 and 2011 newsletters, there are approximately 215 indigenous, described and undescribed species of freshwater fish in North Carolina. Of these, 26% are considered imperiled as either state or federally listed Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 7th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Sharpnose Darter, *Percina oxyrhynchus* (Hubbs and Raney 1939)
Current Status: Special Concern, Proposed Status: Endangered



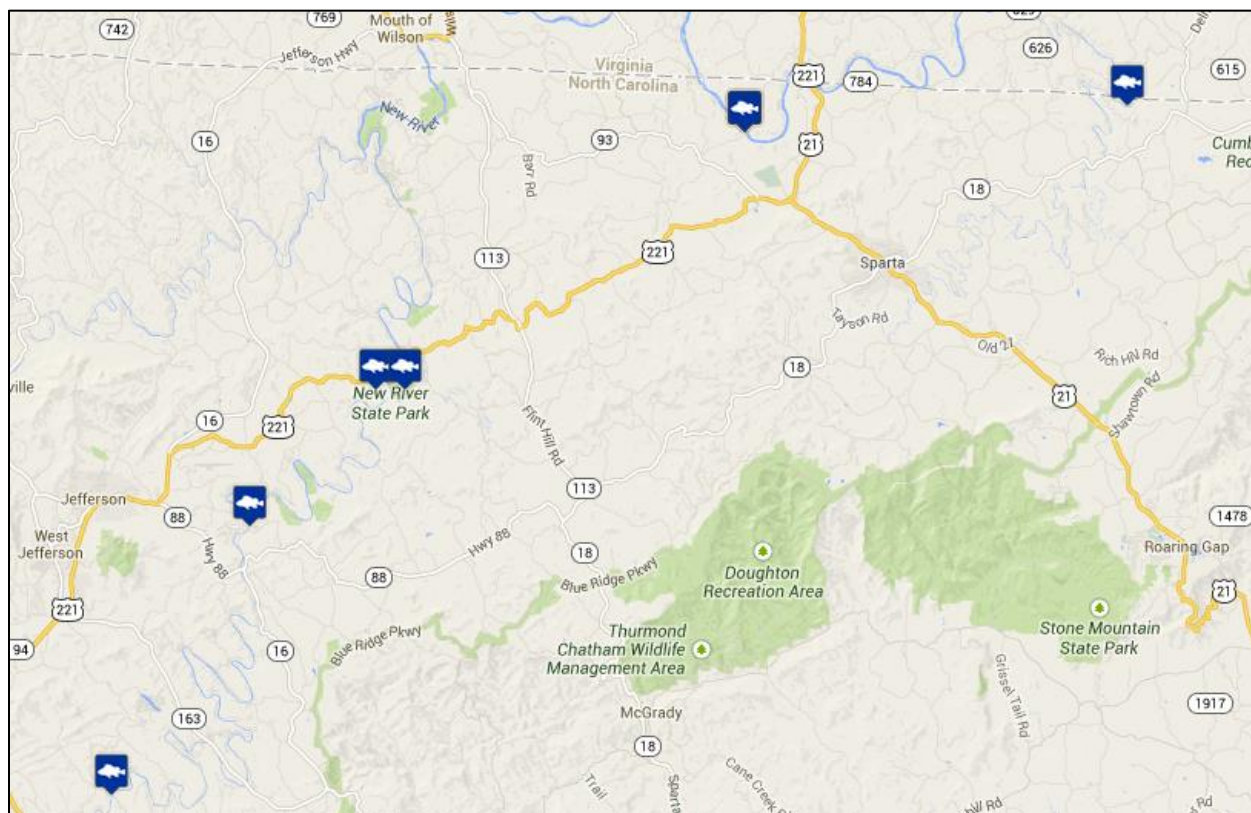
Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Virginia Polytechnic Institute and State University (<http://www.cnr.vt.edu/efish/>).

Type Specimen and Type Locality -- The Sharpnose Darter was described by Hubbs and Raney (1939) based upon specimens collected in 1935 from the Cheat River, a tributary of the Monongahela River in West Virginia and from the New River in Virginia and West Virginia in 1899, 1935, and 1936. The type locality is the Cheat River at Cheat Bridge, Randolph County, WV. The holotype specimen is at the University of Michigan Museum of Zoology (UMMZ Catalog No. 118422).

Description – The Sharpnose Darter is an elongate darter with a sharply pointed snout and broadly joined gill membranes. The species is nearly identical to the Olive Darter, *Percina squamata*, but the breast is either unscaled or only partly scaled with a few embedded scales (Page and Burr 2011). Adults vary from 55-90 mm standard length (Jenkins and Burkhead 1994) or up to 120 mm total length (Page and Burr 2011).

Range – The Sharpnose Darter is indigenous to the Ohio River basin and occurs in southern tributaries to that basin from the Kentucky River drainage in eastern Kentucky to the Monongahela River drainage in western Pennsylvania and West Virginia and south in the New River drainage into North Carolina (Thompson 1980; Page 1983; Page and Burr 2011). In Virginia, the Sharpnose Darter is localized in the Big Sandy River and the New River and its tributaries (Hocutt and Hambrick 1973; Denoncourt et al. 1977; Jenkins and Burkhead 1994). In North Carolina the species is known from the mainstem of the New River, South Fork New River, and the lower Little River in Ashe and Alleghany counties (Menhinick 1991; Menhinick and Braswell 1997; UMMZ and North Carolina State Museum of Natural Sciences (NCSM) collections records queried December 13, 2011). Based upon UMMZ and NCSM collections,

only 10 specimens are known from North Carolina. It has not been found in any other tributaries in the New River drainage in North Carolina (NCSM and DWQ databases queried December 13, 2011; North Carolina Wildlife Resources Agency database queried December 21, 2011).



Distribution of the Sharpnose Darter in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 19, 2014 and is based upon a sample size of eight records.

Habitat – The Sharpnose Darter occupies moderate-gradient large creeks and rivers. Adults are typically found among unsilted gravel, rubble, and boulders in runs and riffles; juvenile are more frequently taken over sand in lesser current (Jenkins and Burkhead 1994). Data collected by Stauffer and Hocutt suggested a distribution related to stream flow and age class (Denoncourt et al. 1977). Adult specimens have been found almost exclusively from fast, turbulent riffles and runs to a meter in depth with large rubble and small boulders interspersed with bedrock; in other words in areas that are extremely difficult places to collect. Juveniles have been found in sandy, cove/beach areas and in areas with slight to moderate current over gravel and small rubble (Denoncourt et al. 1977).

Life History and Ecology – Little biological information is available. Jenkins and Burkhead (1994) reported that like most darters, Sharpnose Darters ate mayfly, caddisfly, midge, and blackfly larvae. Thompson (1977, 1980) inferred a late April to possibly early June spawning period as judged from tuberculation and condition of the gonads. Like another member of the *Swainia* subgenus, Sharpnose Darter are suspected of burying their eggs (Jenkins and Burkhead 1994).

Rationale for Designation – Populations in North Carolina are experiencing habitat degradation and ongoing threats to water quality. For example, in October 2003, 3,000 gallons of sodium hydroxide were spilled into the Middle Fork South Fork New River from the Town of Blowing Rock's water treatment plant in Watauga County. The spill, on a tributary to the South Fork New River, killed more than 14,000 fish (including trout, sculpins, cyprinids, catostomids, and darters) and amphibians. Although the kill extended approximately six miles downstream, the kill did not extended to the known reach where Sharpnose

Darter are found. However, additional wastewater treatment plants at Boone, Jefferson, and Sparta and sediment from land clearing activities can potentially threaten downstream water quality in the South Fork, New and Little rivers. Habitats in many reaches throughout the New River system in North Carolina have become relatively homogeneous, with over-widened channels and long reaches of shallow runs with uniform depth and smaller substrate particles. Good habitats for Sharpnose Darters are increasingly rare. The Wild and Scenic River status of critical parts of the New River offers some protection to this species.

Extensive collecting in North Carolina has resulted in fewer than 10 specimens, perhaps in part because of the difficulty of sampling fast, deep riffles. There has been little effort devoted to collecting juveniles. Recent surveys throughout the New River Basin in 2008 detected only a single specimen from the lower Little River. A State Endangered status is recommended.

Recommendations -- Special care should be taken to ensure that the New River retains its high water quality in this rapidly developing part of the state. The New River from the confluence of the North Fork New River and South Fork New River to the last point at which the New River crosses the North Carolina-Virginia state line is classified by the NC Division of Water Quality as Outstanding Resource Waters (<http://portal.ncdenr.org/web/wq/admin/bog/netsupport/bimsreports>). Special emphasis should also be placed on the highest level of the treatment of wastes discharged into the river and control of siltation from land clearing and agricultural practices.

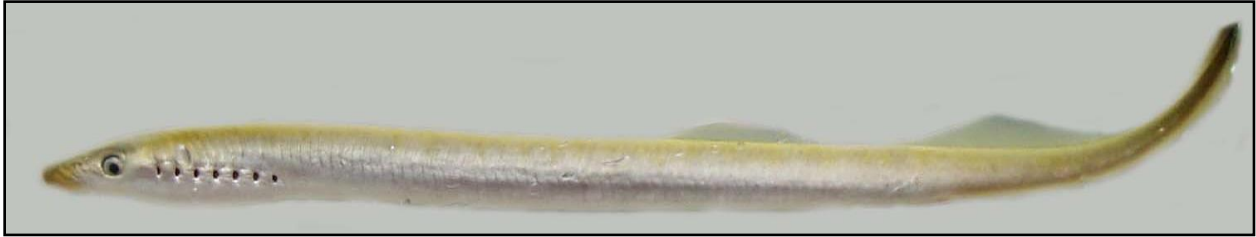
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North Carolina's Imperiled Fish Fauna, Part VIII
Submitted by Bryn H. Tracy, Fred C. (Fritz) Rohde, Wayne C. Starnes, and Stephen J. Fraley
on behalf of the NCWRC's Scientific Council of Fishes

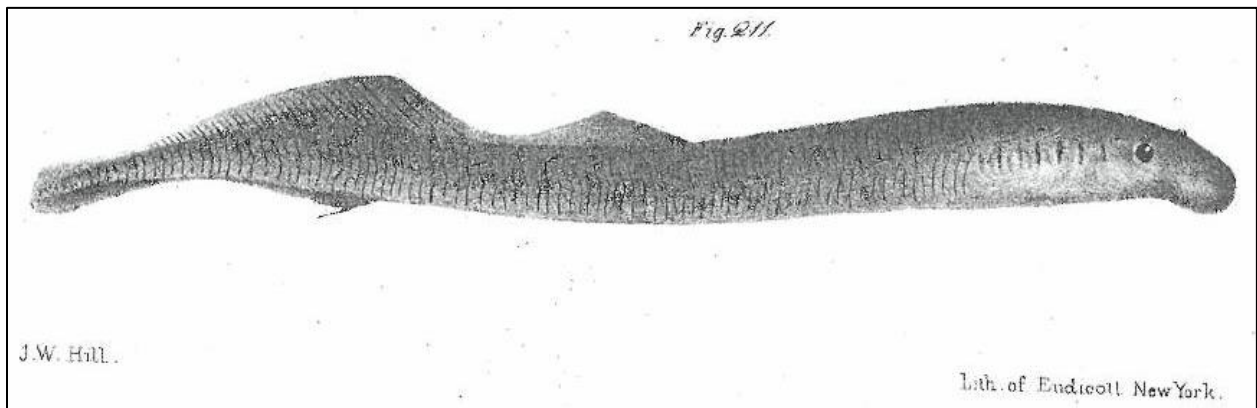
As mentioned in the Chapter's 2010-2012 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are considered imperiled as state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 8th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

American Brook Lamprey, *Lampetra appendix* (DeKay 1842)
Current Status: Threatened, Proposed Status: Endangered



Original photograph by J. Abatemarco of the New Jersey Department of Environmental Protection, Bureau of Freshwater and Biological Monitoring (<http://www.state.nj.us/dep/wms/bfbm/fishpictureessite.html>); photo-enhanced by Fred (Fritz) C. Rohde.

Type Specimen and Type Locality – The American Brook Lamprey was described by James E. DeKay in 1842 based upon specimens received from Providence, Rhode Island and the Hudson River, New York (DeKay 1842). At that time, the common name of the species was Small Lamprey. And, as was often the practice in those days, an exact type locality was not designated. The syntypes are apparently lost. In the 1900s, many earlier accounts of this species referred to it as *Lampetra lamottenii*, described by Charles Lesueur in 1827 from specimens collected near Mine Lamotte in Missouri. These syntypes were also lost and, since the Least Brook Lamprey, *L. aepyptera*, also occurs in that region of Missouri, Bailey (1980) judged *lamottenii* to be unidentifiable and reapplied the next oldest applicable name, *appendix*.

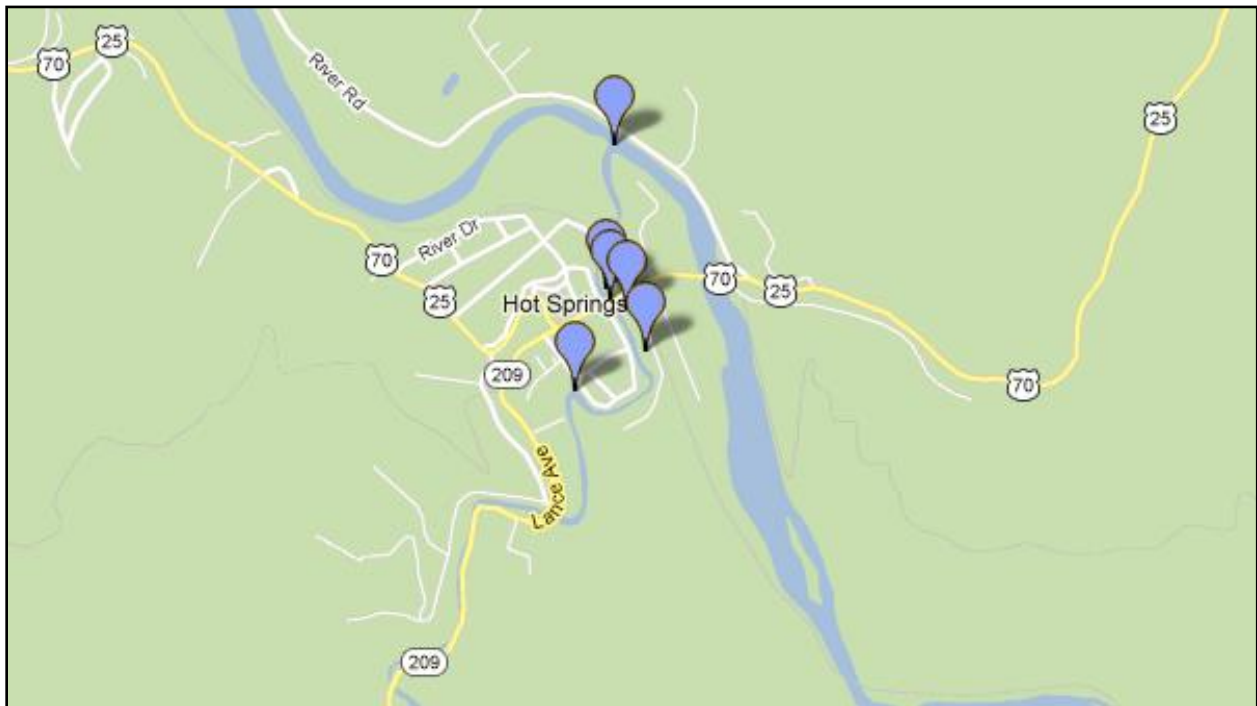


Original illustration of the American Brook Lamprey (Plate 64, Figure 211 from DeKay 1842).

Description – Lampreys are eel-shaped fishes lacking scales, jaws, and paired fins. They have a funnel-shaped mouth, seven gill apertures on each side of the body, a single median nostril, and a cartilaginous skeleton. The American Brook Lamprey is the only Tennessee drainage lamprey with a deeply notched dorsal fin. There are 63 to 73 trunk myomeres, usually 66-70; and pigmentation of adults and ammocoetes (larval lampreys) is uniformly gray/olive above and paler ventrally (Etnier and Starnes 1993). In Tennessee, adults often reach total lengths of 200 mm, and adults up to 300 mm total length are known from more northerly latitudes.

Range – The American Brook Lamprey is found in the St. Lawrence River basin, the Mississippi River basin, exclusive of the Missouri River basin, and along the Atlantic slope from New Hampshire to the Chowan River drainage in Virginia (Rohde 1980; Menhinick and Braswell 1997). Rohde (1979) recognized three subspecies, one of which, *L. a. wilderi*, is found in the lower Chowan River drainage of Virginia just above the North Carolina state line. It is also fairly common in the upland tributaries of east Tennessee (Rohde 1979; Etnier and Starnes 1993).

In August 1977, the first three specimens of the American Brook Lamprey from North Carolina were collected in the French Broad River at the mouth of Spring Creek in the Town of Hot Springs, Madison County (North Carolina State Museum of Natural Sciences [NCSM], Catalogue No. 7883). Since then, the species has been collected only from Spring Creek within the Town of Hot Springs in 1983 (Menhinick 1986; Menhinick 1991), in 1994 and 1995 (Rohde *et al.* 1998; NCSM 26571 and 56657), in 2001 (NCSM 29779), and in 2009 (NCSM 55211 and 55215). Based upon recent records, its known population in North Carolina is restricted to Spring Creek.



Distribution of the American Brook Lamprey in Spring Creek and the French Broad River, Madison County, North Carolina. Map based upon data at the North Carolina State Museum of Natural Sciences, queried April 10, 2012 and is based upon a sample size of seven records.

Habitat – American Brook Lamprey inhabits streams ranging from low to moderate-gradient warm brooks or small rivers (rarely large rivers) to streams that are cool to cold year long. Water is typically clear and substrates range from silt-sand to gravel-rubble (Jenkins and Burkhead 1994). Ammocoetes are found in quiet waters with a silt-sand bottom and adults are usually taken in riffles while spawning over gravel areas near ammocoete beds (Rohde 1980).

Life History and Ecology – Spawning typically occurs in mid-to late March in eastern Tennessee (Seagle and Nagel 1982). Adults move to the upper end of gravel areas and use their sucker-like mouths to move stones to excavate a pit (a larval bed) into which about 1,000 eggs are spawned. Females may produce over 3,000 eggs which hatch in about four days into ammocoetes that burrow into the silt. They obtain nourishment by straining plankton and organic particles from the water and from bottom sediments. Development lasts 5-6 years and ammocoetes transform into adults in late summer over a period of several weeks and spawn the following spring. Adults are non-parasitic and do not feed; they die shortly after spawning.

Rationale for Designation – The presence of a very small localized population in the French Broad River and in Spring Creek at Hot Springs, Madison County, warrants a designation of State Endangered. While other populations may occur in nearby French Broad tributaries, this is yet to be demonstrated despite considerable sampling in the area. Thus Spring Creek may not be readily recolonized in the event of a local extirpation adding to the imperilment of the species in the state. The Spring Creek watershed was recently afforded supplemental water quality classification by the Division of Water Quality as Outstanding Resource Waters (<http://portal.ncdenr.org/web/wq/ps/csu/classifications>).

Recommendations – Field survey efforts should concentrate on appropriate habitat in the lower French Broad River and in Spring Creek to ascertain the present status of this species. Despite being found in Spring Creek in 2009, fairly extensive surveys in 2007 did not detect them in Spring Creek or the lower French Broad River (S. Fraley, pers. com.) indicating the fickle nature of occurrences and varied detection probabilities. Surveys should also be initiated in the Chowan River system, focusing on the Meherrin River subsystem in Northampton and Hertford counties, as they have been found upstream in Virginia.

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North Carolina's Imperiled Fish Fauna, Part IX
Submitted by Bryn H. Tracy, Fred C. (Fritz) Rohde, Wayne C. Starnes, and Ryan J. Heise
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2012 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are considered imperiled as state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 9th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

"Broadtail" Madtom, *Noturus* sp. cf. *leptacanthus* (an undescribed taxon)
Current Status: Special Concern, Proposed Status: Threatened



"Broadtail" Madtom from Lake Waccamaw (top) and South River (bottom). Photographs by Fred (Fritz) C. Rohde.

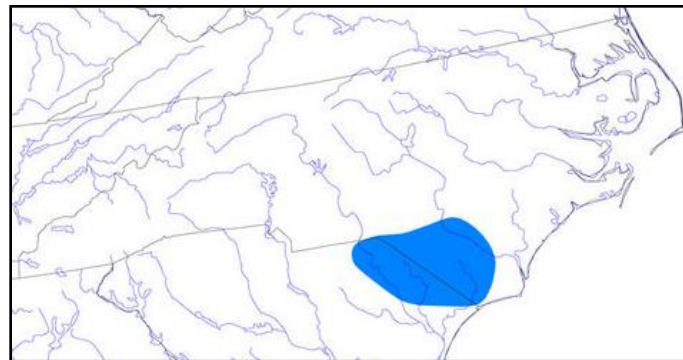
Type Specimen and Type Locality – This species of madtom has not been formally described, but has been known to researchers since the mid-1970s (Jenkins and Palmer 1978). Upon scientific description, a type specimen and type locality will be so designated. The earliest known vouchered records for the

“Broadtail” Madtom go back to 1960 and 1962 when specimens were collected from the Lumber River, Cape Fear River at Lillington, the Northeast Cape Fear River at Castle Hayne, and Great Coharie Creek as part of the NCWRC’s state-wide survey of fishes (Starnes and Hogue 2011). Menhinick et al. (1974), based upon communications with Bill Palmer (NCSM) and Robert Jenkins (Roanoke College), reported specimens from Bladen, Columbus, and Brunswick counties.

Description - This small humped-back madtom of the southeastern Coastal Plain differs from other North Carolina madtoms by having small serrae present only on the distal part of the pectoral spine; the fins are usually clear with dark streaks near the base; there are 13 to 16 anal rays, and the nasal barbel does not extend beyond the eye. The head is exceptionally broad. The body is light with dark spots in the river form and uniform gray in the Lake Waccamaw form. Adults reach 33 to 65 mm total length (Rohde et al. 2009).

The “Broadtail” Madtom may be separated from the Margined Madtom, *Noturus insignis*, by the specks on the body and the blotch on the caudal fin. In adjacent South Carolina, the “Broadtail” Madtom may be distinguished from the Speckled Madtom, *Noturus leptacanthus*, by the presence of the caudal fin blotch, a rounded caudal fin (square in *N. leptacanthus*) and a banjo-shaped body when viewed from above (versus tapered gradually in *N. leptacanthus*) (Rohde, et al. 2009).

Range - This undescribed species is endemic to North Carolina and South Carolina at widely scattered localities in the Sand Hills and southeastern Coastal Plain from the Cape Fear River system to the Edisto River system. Historical and recent records of the “Broadtail” Madtom in North Carolina include those from the Cape Fear River system (Northeast Cape Fear River, Black River, Coharie Creek, Six Runs Creek, and South River), Lumber River system (Drowning Creek, Big Swamp Creek, Juniper Creek, Aberdeen Creek, and Lumber River), and the Waccamaw River system (Lake Waccamaw, Waccamaw River, and Cawcaw Swamp) (F. C. Rohde, pers. com. and vouchered specimens at the North Carolina State Museum of Natural Sciences). Distinct populations may occur in Lake Waccamaw and the Waccamaw River (Menhinick 1986, 1991; Shute, et al. 1981). Two genetic studies have been completed with the results of one of the studies published in the peer-reviewed literature (Bennetts, et al. (1999); F. C. Rohde, pers. com.). In both studies, results were not clear and did not correspond to river and lake forms. Bennetts, et al. (1999) concluded that the “Broadtail” Madtom is polyphyletic, with two genetically divergent lineages that do not correspond to lake and river designations. However, more recent interpretation of the data showed that “Broadtail” Madtom is monophyletic and the Lake Waccamaw population appears to be an old hybrid with the Margined Madtom and somewhat distinct (F. C. Rohde, pers. com.).



Distribution of the "Broadtail" Madtom in North Carolina (top) and in the Carolinas (bottom). Maps are based upon data at the North Carolina State Museum of Natural Sciences, queried May 30, 2012 (based upon a sample size of 19 records) and from the Tree of Life Web project (http://tolweb.org/noturus_species/69895).

Habitat - During the day the "Broadtail" Madtom lies partially buried on the bottom of small to medium-sized streams, in areas about 0.5 m deep with a good flow, generally over gravel or coarse sand, often associated with pondweed, *Potamogeton* spp. and patches of submerged woody debris. In Lake Waccamaw it is most commonly collected near the shore in discarded beverage cans and bottles (Shute et al. 1981); it prefers sandy vegetated areas (F. C. Rohde and W. C. Starnes, pers. obs.).

Life History and Ecology – Very little has been published on the life history and ecology of the “Broadtail” Madtom, but is probably similar to that of other, closely related madtom species. It probably feeds on benthic insect larvae at night. Based upon the occurrence of gravid females, the “Broadtail” Madtom probably spawns from late May to June and deposits eggs in clusters under logs or in tin cans and bottles, or on the underside of flat tiles tilted on the bottom in Lake Waccamaw (Rohde et al. 2009). The eggs are probably guarded by one of the parents. Individuals probably mature in 1 year and live 2 to 3 years. Status surveys are currently being conducted by Ryan Heise, Brenna Jones (NCWRC), NC State Parks, and Fritz Rohde. Small artificial reefs or “Madtom hotels” have been placed in Lake Waccamaw to help assess populations levels (NCWRC 2012).

Rationale for Designation - Between 1979 and 1981, “Broadtail” Madtom seemed to be relatively common in Lake Waccamaw and were thought to outnumber Tadpole Madtom, *N. gyrinus* (Shute et al. 1981). However, recent monthly surveys of Lake Waccamaw by Heise and Jones have only collected Tadpole Madtoms in their traps. If Broadtail Madtom is still in the lake, they are extremely rare (R. Heise, pers. obs.). In fact, the Broadtail Madtom has not been collected from Lake Waccamaw since June 2002 (NCSM 31929); causes for its decline are unknown. Recent surveys in the South River indicate a decreasing trend in population sizes, possibly associated with increasing numbers of Flathead Catfish, *Pylodictis olivaris*. Because of its restricted distribution and decreasing population size, especially in Lake Waccamaw, this small, undescribed species is assigned State Threatened status.

Recommendations - Studies of its life history and behavior are needed. Its occurrence in streams affected by increasing developmental pressure and runoff from confined animal operations, necessitates special steps be taken to control pollution in the South and Lumber rivers.

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North Carolina's Imperiled Fish Fauna, Part X
Submitted by Bryn H. Tracy, Fred C. (Fritz) Rohde, Wayne C. Starnes, Ryan J. Heise, and
Brena Jones on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2012 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are considered imperiled as state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 10th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

"Thinlip" Chub, *Cyprinella* sp. cf. *zanema* (an undescribed taxon)
Current Status: Special Concern, Proposed Status: Threatened



Photograph by Fred (Fritz) C. Rohde.

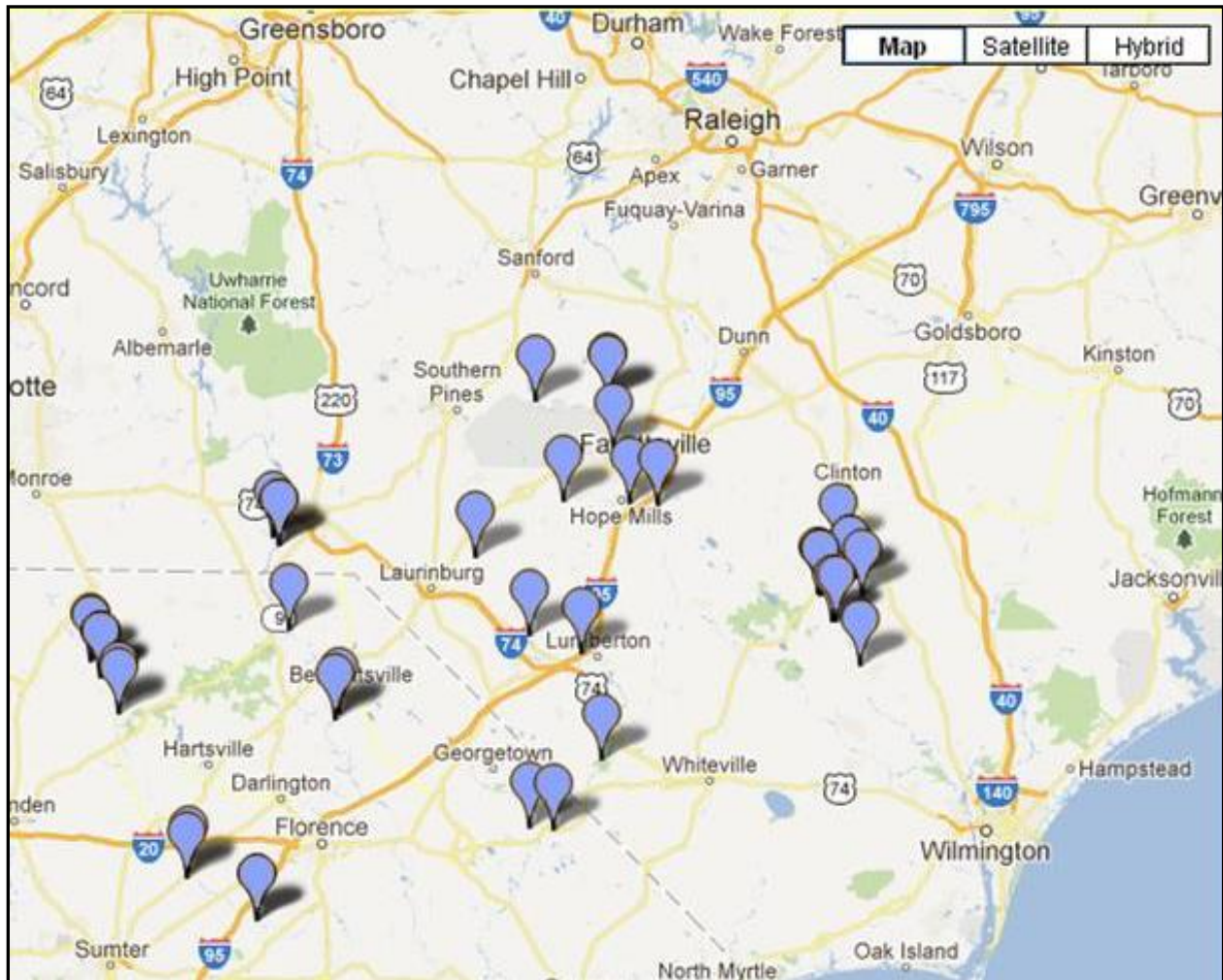
Type Specimen and Type Locality – This species of cyprinid has not been formally described, but has been known to researchers since the early 1970s (Menhinick et al. 1974; Jenkins and Lachner 1980). Upon scientific description, a type specimen and type locality will be so designated. The earliest known vouchered records at the North Carolina State Museum of Natural Sciences (NCSM) for the "Thinlip" Chub go back to 1962. During that year, specimens were collected from two sites on Rockfish Creek, a tributary to the Cape Fear River, in Cumberland County as part of the NCWRC's state-wide survey of fishes (NCSM 5512 and NCSM 55864; Starnes and Hogue 2011). Two unvouchered specimens were apparently collected in 1961 and reported as Thicklip Chub, *Cyprinella labrosa*, (Louder 1962) from the Lumber River at Fair Bluff in Columbus County (Starnes and Hogue 2011).

Description – The "Thinlip" Chub is a barbeled *Cyprinella* with an inferior mouth. It is slender and elongate with a compressed body that is deepest at the nape and flattened below. It is pale with a dusky lateral stripe and the dorsal scales are lightly outlined with dark brown. The origin of the dorsal fin is behind the origin of the pelvic fin. It has large eyes, 8 anal rays, 38 or 39 lateral line scales, and 1,4-4,1 pharyngeal teeth. Adults range from approximately 45 to 85 mm total length (Rohde et al. 2009).

The "Thinlip" Chub is highly similar in appearance to the Santee Chub, *Cyprinella zanema*. However, the "Thinlip" Chub is confined to the Sand Hills and Coastal Plain of the Cape Fear and Pee Dee rivers, whereas the Santee Chub is found in the Piedmont and Eastern Blue Ridge Foothills of the Santee River drainage (Rohde et al. 2009). Tentatively considered to be a subspecies of the Santee Chub (Jenkins

and Lachner 1980) based upon minor morphological differences, recent DNA work suggests that it deserves species status (Rohde et al. 2009).

Range – In North Carolina, the “Thinlip” Chub is endemic to upper Coastal Plain streams of the Cape Fear River drainage (Little River in Cumberland, Hoke, and Moore counties; Rockfish Creek in Hoke County; and the South and Black rivers in Bladen and Sampson counties), the Lumber River drainage from near Wagram downstream to near Fair Bluff near the state line, and the Pee Dee River below Blewett Falls Reservoir (Menhinick 1991; NCSM records). In South Carolina, the species is endemic to the Lumber River, Lynches River, Little Lynches River, the Little Pee Dee River, and the Pee Dee River at the junction of Thompson Creek and downstream (Rohde et al. 2009; NCSM records). Its distribution shows an interesting parallel with that of the “Broadtail” Madtom (please refer to the Chapter’s September 2012 newsletter).



Distribution of the “Thinlip” Chub in the Carolinas. Map is based upon the North Carolina State Museum of Natural Sciences database, queried August 27, 2012 and is based upon 46 records.

Habitat - Prefers pool areas of medium-sized streams with moderate velocity, over sandy substrate; it often schools near stumps or other cover. In the Lynches River, fish have been taken over gravel-bottom riffles and more commonly, in sand-bottom runs (Rohde et al. 2009).

Life History and Ecology - Little is known of the life history and ecology of the “Thinlip” Chub. Based upon nuptial coloration, it probably spawns from mid- to late summer (Rohde et al. 2009). Stomach contents of

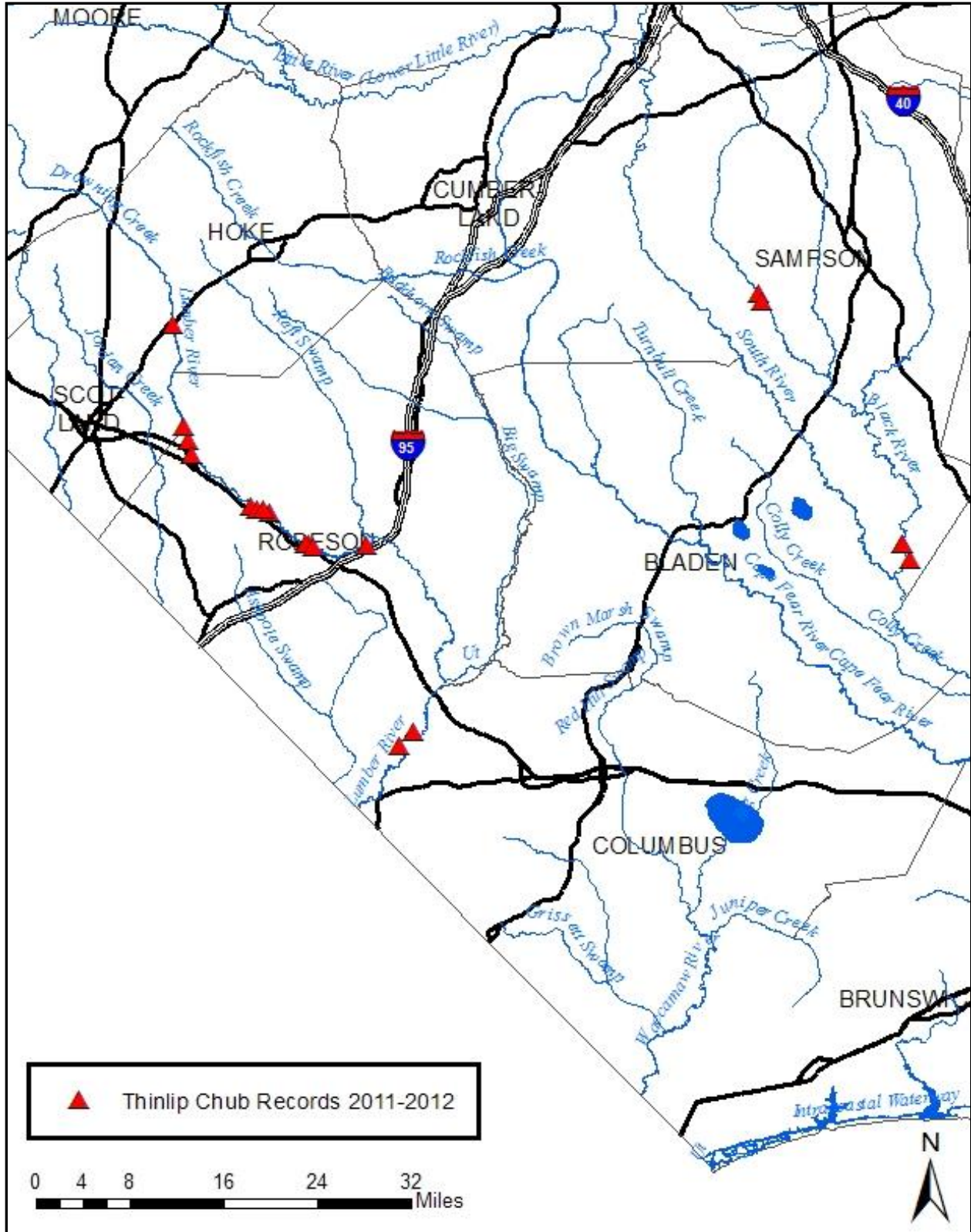
fish from the Lynches River in May 1996 contained primarily dipteran larvae; mayfly and stonefly nymphs and caddisfly larvae were of minor importance (Rohde et al. 2009).

Rationale for Designation - During the late 1970s, the "Thinlip" Chub was very common in the Black River in Sampson County. However, spills from concentrated animal feeding operations in the 1980s and 1990s may have been responsible for drastically reducing its numbers in this river (F. C. Rohde pers. com. July 2009). Abundance seems to vary widely in some other streams from which it has been recorded over the years and, in some years, considerable targeted efforts may fail to yield specimens, indicating that populations occasionally drop below detection levels and therefore possibly to the brink of extirpation. This species is important to our understanding of the systematics and biogeography of *Cyprinella*. Because of its restricted distribution and habitat and water quality degradation in the Black River, the "Thinlip" Chub is assigned State Threatened status.

Recommendations - Appropriate systematic studies and research on its biology need to be undertaken. Status surveys have been recently conducted by Brena Jones and Ryan Heise with the North Carolina Wildlife Resources Commission. In addition, there should be an effort to enforce water quality standards for the South River and other streams where it occurs. Even though the Black River from its source to the Cape Fear River and the South River from Big Swamp to the Black River are supplementally classified as Outstanding Resource Waters by the North Carolina Division of Water Quality, there have been apparent declines of this species in those areas. Its occurrence in streams affected by increasing developmental pressure and runoff from confined animal operations, necessitates special steps be taken to control pollution in the South and Lumber rivers.

Literature Cited and Recommended Readings

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Extant populations of the “Thinlip” Chub in the Black River and Lumber River, North Carolina, based upon collections made by the North Carolina Wildlife Resources Commission (NCWRC) in 2011 and 2012. Sites where the “Thinlip” Chub was surveyed for, but not found, are not shown. Map is based upon the NCWRC database, queried by Brena Jones, September 21, 2012.

North Carolina's Imperiled Fish Fauna, Part XI
Submitted by Bryn H. Tracy and Wayne C. Starnes
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2012 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are considered imperiled as state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 11th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Mimic Shiner, *Notropis volucellus* (Cope)
Current Status: None, Proposed Status: Special Concern



Photograph by Uland Thomas, courtesy of the Southeastern Fishes Council, <http://www.sefishescouncil.org/>.

Type Specimen and Type Locality – The Mimic Shiner was described by Edward Drinker Cope in 1865 based upon specimen(s) from the Detroit River at Grosse Isle, Wayne County, Michigan (Cope 1865). The type specimen has not been located (Gilbert 1978).

Description – The Mimic Shiner is a small and relatively non-descript minnow reaching a maximum total length of 65 mm, although most individuals encountered are smaller. Based on Etnier and Starnes (1993), color in life is translucent silvery on the sides and gray to faintly amber on the back; the dorsolateral scales are edged with black pigment and a faint triangular caudal spot is often present. Preserved specimens have a dusky midlateral stripe extending from the caudal base to about midbody and a preorbital bar on either side of the snout. The snout is shorter than the eye diameter and the mouth is nearly horizontal. Anal-fin rays are 8, pectoral-fin rays 13-17, pelvic-fin rays 8, and pharyngeal teeth are 4-4. Scales are most often lacking on the breast, occasionally present.

A primary diagnostic trait of Mimic Shiner is the markedly elevated anterior line scales, best seen in the 3rd to the 7th scales from the head (Jenkins and Burkhead 1994). Another feature of Mimic Shiner is the extensive development of neuromasts-tiny pitlike sensory structures. Neuromasts are best developed on the anterior half of the head dorsum, snout, subnasal area, around the orbit, particularly on the cheek, and on the anterior portion of lateral line scales (Jenkins and Burkhead 1994). The New River Shiner, *Notropis scabriceps*, is superficially quite similar to, and often collected with, Mimic Shiner. Characters distinguishing the two species may be found in Jenkins and Burkhead (1994). Similar looking species that may be encountered in the Neuse and Tar River drainages and possibly confused with Mimic Shiner include Spottail Shiner, *N. hudsonius*, Swallowtail Shiner, *N. procne*, Ironcolor Shiner, *N. chalybaeus*, and

the extremely rare and state endangered Bridle Shiner, *N. bifrenatus*. Likewise, similar looking species that may be encountered in the Roanoke River drainage and possibly confused with Mimic Shiner include Spottail Shiner, Swallowtail Shiner, and Whitemouth Shiner, *N. alborus*. These species may be separated from one another using the key couplets in Menhinick (1991).

Range – Mimic Shiner, as currently regarded, has a wide distribution over much of the eastern United States (Gilbert and Burgess 1980), including some geographically disjunct populations in Atlantic coastal drainages (Etnier and Starnes 1993). As such, pending revisionary studies, it may well represent a complex of two or more species. Jeremy Wright, New York State Museum, is currently launching a study of the complex. Forms of this shiner occur widely in Gulf of Mexico drainages from the Mississippi River and Mobile Bay drainages west to the Nueces River of Texas and, to the north, in the Great Lakes, St. Lawrence, and Hudson Bay drainages, with introductions in New England. On the mid-Atlantic Slope, native populations are known from the James River of Virginia south to the Neuse River of North Carolina. In North Carolina (North Carolina State Museum of Natural Sciences collection records [<http://collections.naturalsciences.org/searchFishes.aspx>]; FishNet2 [<http://www.fishnet2.net/>], NC DWQ database [<http://portal.ncdenr.org/web/wq/ess/bau/ncibi-data>]; NCWRC aquatics database; Menhinick 1991; Starnes and Hogue 2011), disparate populations are known in the Tar and Neuse rivers and their larger tributaries on the Atlantic Slope, the New River of the Ohio River drainage, and in the French Broad portion of the upper Tennessee River drainage, including the French Broad River proper and the Nolichucky River subbasin, mainly Cane and Toe river systems. Menhinick, et al. (1974) reported Mimic Shiner as common in the New River basin, although none were reported by Richardson and Carnes (1964) or vouchered from this drainage (Starnes and Hogue 2011). Menhinick (1991) also plotted a single questionable record from the Little Tennessee River system in the southwestern portion of the state. Much sampling in the Little Tennessee River system since then has failed to detect any Mimic Shiners (North Carolina Wildlife Resources Commission Aquatics Database, 2009). To the north, Virginia populations on the Atlantic Slope are curiously sequestered into widely separated headwater portions of the Roanoke and James drainages and the Coastal Plain portions of the Chowan and Meherrin drainages (Jenkins and Burkhead 1994).

There is one lot (at the University of Michigan Museum of Zoology Catalogue No. UMMZ 177032) collected on November 28, 1963 by Smith, Woodbourne, and Anderson from the Grassy Creek system of the Roanoke River drainage in Granville County. Originally identified by Reeve Bailey and C. Lavett Smith, re-examined in April 2013 by Doug Nelson (University of Michigan), and verified in May 2013 by Wayne Starnes and Bryn Tracy, this lot represents the only known record from the Roanoke River drainage, including the Dan River, in North Carolina and from the entire Roanoke River drainage downstream from its headwaters in Virginia. The six specimens are 37-50 mm total length (31-40 standard length) and are readily recognizable as Mimic Shiner. The examination of Smith's field notes, including a list of other species collected from the stream within Grassy Creek subsystem (sent as a pdf file courtesy of Scott Schaefer, American Natural History Museum, NY to Wayne Starnes on May 21, 2013), did not disprove that the collection was not made from the Grassy Creek subsystem. As such, it constitutes the only known record from the North Carolina portion of the greater Albemarle Sound basin. Similar looking Whitemouth Shiner and Swallowtail Shiner in the North Carolina State Museum of Natural Sciences and Division of Water Quality collections from the Grassy Creek and nearby tributaries to the Roanoke River were re-examined for possible misidentifications. None were mis-identified.

Mimic Shiner was reported by Carnes (1965) from six sites in the Roanoke River basin (Roanoke River below Plymouth, Roanoke River near Hamilton, Roanoke River near Weldon, Gardner Creek, Cashie River near Sans Souci Ferry, and Cashie River near Windsor), but vouchers specimens were retained from only one site and these were re-identified as Spottail Shiner (Starnes and Hogue 2011). The un-vouchered material were likely misidentified Spottail Shiner because at one site (Roanoke River below Weldon), 370 specimens were collected from this large river where Spottail Shiner are known to be common.

Uncatalogued, but identified, lots at the North Carolina State Museum of Natural Sciences include additional specimens from the Tar, upper Neuse, and New River drainages.



Distribution of the Mimic Shiner in the North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried May 21, 2013 and is based upon a sample size of 60 records. Not shown is a 1997 record from Little Fishing Creek, Halifax County, that is vouchered with the DWQ fish collection.

Habitat - Mimic Shiners typically inhabit rivers and larger creeks where they are most frequently encountered in pool areas or runs with minimal to moderate current.

Life History and Ecology - The biology of this shiner has not been studied extensively but, based on Midwestern populations of the Mimic Shiner complex (Moyle 1973, Etnier and Starnes 1993, Jenkins and Burkhead 1994), this minnow has a lifespan of 2-3 years and feeds principally on microcrustaceans, midge larvae, and fallen terrestrial insects. Diurnal migrations have been documented with movement to deeper waters at night. Based on breeding tubercle development, a protracted spawning season is indicated over the summer months.

Rationale for Designation - The oddly distributed Mimic Shiner, or forms thereof, may represent two, possibly three, cryptic taxa or evolutionarily significant units in North Carolina. This species has relatively localized distributions in the state and the river systems inhabited by its various forms have been subjected to increasing pressure from development in recent decades, particularly the Neuse, Tar, and New rivers basins. Given this situation, it may become vulnerable to extirpation from one or more of these river systems in the future. A State Special Concern status is recommended.

Recommendations - Molecular studies are needed to determine the degree of genetic variation among the various populations in the region and a more concerted effort should be made to assess the status of this species in each river system in which it occurs. Nondescript as it is, this species can be easily overlooked and may or may not have more robust populations than currently available voucher collections would indicate.

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North Carolina's Imperiled Fish Fauna, Part XII
Submitted by Bryn H. Tracy, Wayne C. Starnes, Fred C. (Fritz) Rohde, and Ryan Heise
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2013 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 12th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Waccamaw Killifish, *Fundulus waccamensis*, Hubbs and Raney 1946
Current Status: Special Concern, Proposed Status: Threatened



Photograph by Fred (Fritz) C. Rohde, courtesy of the Southeastern Fishes Council, <http://www.sefishescouncil.org/>.

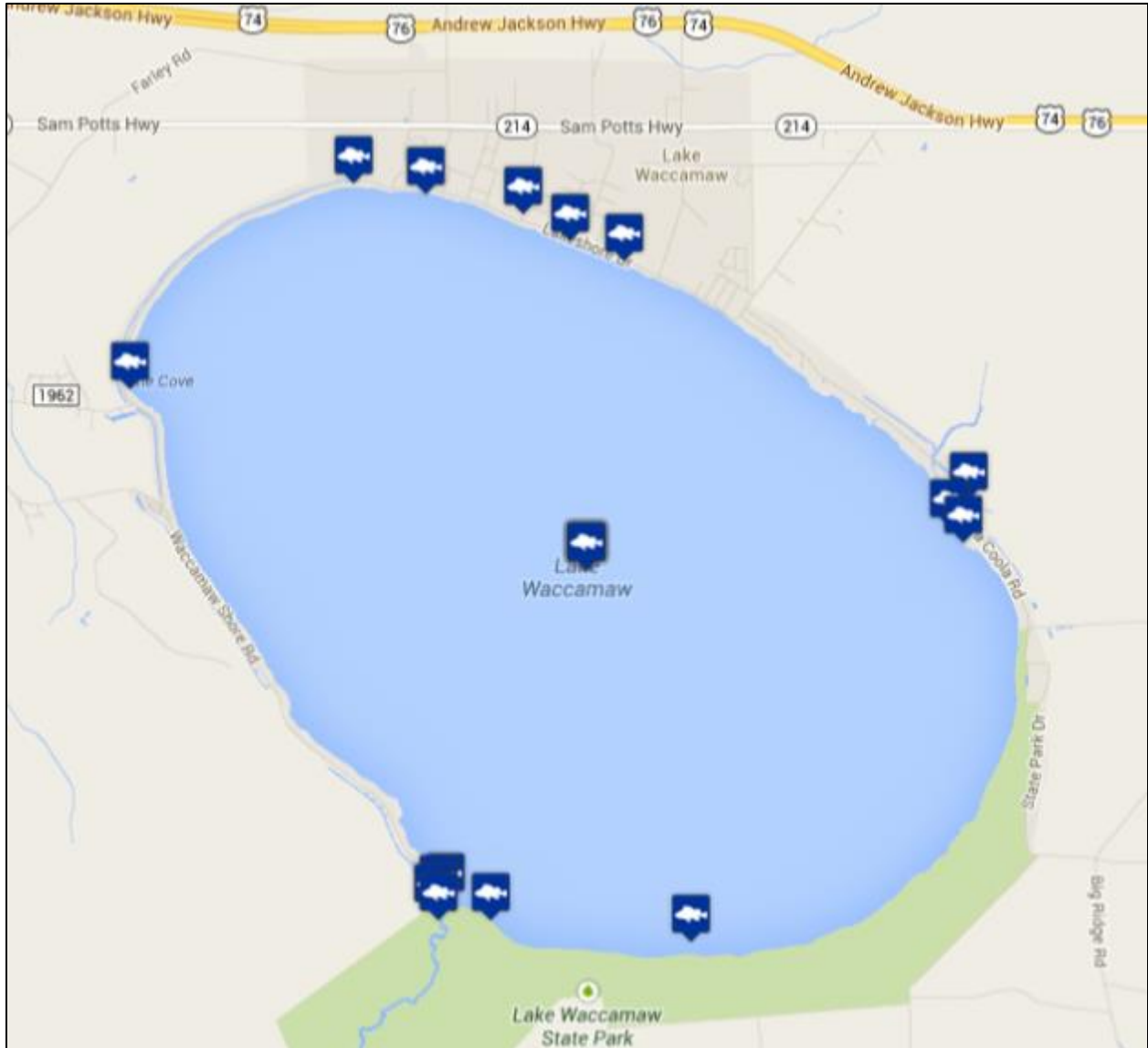
Description - The Waccamaw Killifish has an elongate head and body, slender caudal peduncle, flattened snout, small scales, silvery to olive base color, dark bars on the sides, and blue-green to green-gold iridescence, especially on males. Adults are 45 to 85 mm standard length and modally have 52 to 58 lateral line scales (range 50-64) and 4 or 5 gill rakers. The depth of the caudal peduncle is 2.8-3.5 times in the length of the caudal peduncle (Menhinick 1991). Males have 15 to 20 dark vertical bars usually wider than the light interspaces and females have 12 to 16 narrow dark vertical bars. The Waccamaw Killifish may be confused with the Banded Killifish, *Fundulus diaphanus*, but the Banded Killifish has modally 36-39 lateral line scales (range 34-46), and depth of the caudal peduncle is 2.0-2.8 times in the length of the caudal peduncle (Menhinick 1991). It is not known to occur in the lake.

The Waccamaw Killifish and "Lake Phelps" Killifish (which will be discussed in the next series on North Carolina's imperiled fish fauna) were formerly considered a single species (Bailey 1977; Shute 1980; Menhinick 1991), with the Lake Phelps population possibly introduced from Lake Waccamaw. Subsequent genetic and morphometric analyses by Grady, Krabbenhoft, Quattro, and Rohde (unpublished data) suggest these two killifishes evolved independently in their respective lakes from isolated populations of the Banded Killifish. T. J. Krabbenhoft, Department of Biology, University of New Mexico is conducting further studies on the systematics of this species group.

Type Specimen and Type Locality - The Waccamaw Killifish was described by Carl L. Hubbs and Edward C. Raney in 1946 based upon 260 specimens collected by Raney, E. A. Lachner, and R. A. Pfeifer from the sandy shoals along the north shore, near the Jones Hotel on NC 214, on the night of March 30, 1941,

in Lake Waccamaw Columbus County, North Carolina (Hubbs and Raney 1946). The holotype is at the University of Michigan's Museum of Zoology (UMMZ), Catalogue No. 138473.

Range - The Waccamaw Killifish is endemic to Lake Waccamaw and its adjacent canals (Shute *et al.* 1981; Menhinick and Braswell 1997; Krabbenhoft, et al. 2009). In Lake Waccamaw, it is the only killifish normally present, but in the adjacent canals, it occurs with the Lined Killifish, *F. lineolatus* and now the recently invading Golden Topminnow, *F. chrysotus*. Thirty years ago, the population of the Waccamaw Killifish was estimated to be 1-10 million fish (Lindquist and Yarbrough 1982). In a collaborative effort, NCWRC and State Parks are conducting long-term monitoring surveys. Annual catch-per-unit-effort data (2009-2012) indicate that Waccamaw Killifish continue to be abundant and are widely distributed in Lake Waccamaw (Heise et al. 2013).



Global distribution of the Waccamaw Killifish, Columbus County, North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried June 07, 2013 and is based upon a sample size of 23 records. The locality marker in the center of the lake is for a record with imprecise locality information rather than a true capture point.

Habitat - Lake Waccamaw is a 3,615 hectare Carolina bay lake that is unique because of its water chemistry (near-neutral pH) and large size, as compared to other natural bay lakes. The Waccamaw Killifish occurs in large schools in shallow water along the sandy to muddy shorelines, often in association with submerged or emergent vegetation (Shute, 1980, Shute *et al.* 1983); it also occurs in canals adjacent to the lake.

Life History and Ecology - Unlike many killifish species that occur predominantly near the surface, the Waccamaw Killifish is an epibenthic species, spending most of its time near the bottom, and seems to be an opportunistic feeder consuming primarily benthic chironomid larvae and amphipods (Shute 1980; Lindquist and Yarbrough 1982). During spawning, which occurs from April through August, males defend territories with lateral displays and spawn with passing females on silty substrate. Adult females contain about 30 to 50 mature eggs (Shute *et al.* 1983).

Rationale for Designation - Lake Waccamaw is a very unique environment, once thought to be in danger of accelerated eutrophication (Lindquist and Yarbrough 1982; Casterlin, *et al.* 1982). It is now threatened by the exotic and invasive aquatic macrophyte *Hydrilla verticillata* which was discovered in the northwestern side of the lake in 2012. The infestation is relatively recent (perhaps 1-3 years) and treatment was initiated in June 2013 (Heise, *et al.* 2013). Lake Waccamaw is supplementally classified as Outstanding Resource Waters by the North Carolina Division of Water Quality. Waccamaw Killifish and all endemic or unique organisms occurring in Lake Waccamaw deserve special attention. The Waccamaw Killifish is assigned State Threatened status, which is consistent with the status of other species endemic to Lake Waccamaw (e.g., Waccamaw Silverside, *Menidia extensa*, Waccamaw Darter, *Etheostoma perlongum*, and "Broadtail" Madtom, *Noturus sp. cf. leptacanthus*).

Recommendations - Continued attention should be given to preventing accelerated eutrophication and widespread coverage by *Hydrilla* in Lake Waccamaw. Lake Waccamaw receives partial protection by the presence of the Lake Waccamaw State Park along its southeastern shoreline, which could be useful for habitat protection and restoration activities, if needed. Further genetic studies of the two lake-endemic killifishes and nearby populations of the Banded Killifish are needed to resolve the systematic and taxonomic questions of this group.

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North Carolina's Imperiled Fish Fauna, Part XIII
Submitted by Bryn H. Tracy, Wayne C. Starnes, and Fred C. (Fritz) Rohde
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2013 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 13th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

"Lake Phelps" Killifish, *Fundulus* sp. cf. *diaphanus* (an undescribed taxon)
Current Status: Special Concern, Proposed Status: Threatened



Photograph by Fred (Fritz) C. Rohde.

Type Specimen and Type Locality – This species of killifish has not been formally described, but has been known to researchers to be different from the Waccamaw Killifish, *Fundulus waccamensis*, and the Banded Killifish, *F. diaphanus*, since the late 1970s. Upon scientific description, a type specimen and type locality will be so designated.

The earliest known vouchered records at the North Carolina State Museum of Natural Sciences (NCSM) for the "Lake Phelps" Killifish go back to 1964. During June of that year, 25 specimens were collected from two sites on Lake Phelps by Dr. Joseph R. Bailey and Duke University students (NCSM 44211 and NCSM 44212). Additional specimens were collected in 1972 and 1975 (NCSM 71568 and NCSM 44214) and the occurrence was officially reported in Lake Phelps by Bailey (1977).

Description - The "Lake Phelps" Killifish has an elongate head and body, slender caudal peduncle, flattened snout, small scales, silvery to olive base color, dark bars on the sides, and blue-green to green-gold iridescence, especially on males. Adults are 45 to 85 mm standard length and modally have 52 to 58 lateral line scales (range 50-64) and 4 or 5 gill rakers. The depth of the caudal peduncle is 2.8-3.5 times in the length of the caudal peduncle (Menhinick 1991). Males have 15 to 20 dark vertical bars usually wider than the light interspaces and females have 12 to 16 narrow dark vertical bars. The "Lake

Phelps" Killifish may be confused with the Banded Killifish, *Fundulus diaphanus*, but the Banded Killifish has modally 36-39 lateral line scales (range 34-46), and depth of the caudal peduncle is 2.0-2.8 times in the length of the caudal peduncle (Menhinick 1991).

The "Lake Phelps" Killifish and the Waccamaw Killifish (which was discussed in the September 2013 series on North Carolina's imperiled fish fauna were formerly considered a single species (Bailey 1977; Shute 1980; Menhinick 1991), with the Lake Phelps population possibly artificially introduced from Lake Waccamaw (Wiley and Mayden 1985; Wiley 1986). In 1979 or early 1980, Dr. David G. Lindquist (UNC-Wilmington) and his students, J. R. Shute and P. W. Shute, may have been the first to realize that, contrary to the beliefs of Dr. Bailey, the species of *Fundulus* inhabiting Lake Phelps was morphologically different from *F. waccamensis*, which is endemic to Lake Waccamaw (letter from D. G. Lindquist to J. R. Bailey, dated April 21, 1980; from the correspondence files of Dr. Edward F. Menhinick [UNC-Charlotte] archived at NCSM). Separately, Drs. Lindquist and Menhinick, also did some comparative external morphometric studies of specimens of *Fundulus* specimens from the two lakes in the early 1980s (above cited letter and Menhinick 1980), but neither published their results beyond informal communications. Shute et al. (1981) did state that: "*Specimens in Lake Phelps examined by us [J. R. Shute, P. W. Shute, and D. G. Lindquist] and E. F. Menhinick (pers. comm.) were found to differ slightly from F. waccamensis in respect to head length, interorbital width, and caudal peduncle length*".

Subsequent morphometric analyses by Krabbenhoft (2006) suggested these two allopatric killifishes independently evolved more elongate morphologies in their respective lakes from isolated populations of the Banded Killifish. Analysis of mitochondrial sequence data suggests that this population is independently derived from local stream populations of *F. diaphanus*, and is thus neither a relictual population of *F. waccamensis*, nor the result of bait bucket introduction (Quattro et al., unpublished) (Krabbenhoft 2006). Phylogenetic analysis of mitochondrial DNA sequences have been performed (Grady et al. 2000), but these data have not been published. The alpha-level systematics of the Lake Phelps *Fundulus* continues to require further study (Krabbenhoft 2006).

An analogous and very interesting situation may occur in Shearon Harris Reservoir in Chatham/Wake counties, North Carolina, where *Fundulus* specimens, bearing high scale counts and other traits similar to the Waccamaw and Phelps lakes forms, have been captured there on several occasions between 2006 and 2010 (NCSM 23370, NCSM 23371, NCSM 44582, NCSM 56051, and NCSM 60781). Because that reservoir is relatively new and very geographically remote from either of those lakes, these specimens may represent an introduction from one of those locales or, alternately, possibly an introduction of Banded Killifish that have very rapidly assumed traits associated with a lacustrine environment. Analyses of DNA may shed light on the provenance of this population.

Range - The "Lake Phelps" Killifish is endemic to Lake Phelps, where it is the only known killifish present. The similar Banded Killifish occurs mainly in tidal waters in North Carolina and has not been reported in Lake Phelps, but occurs in the Scuppernon River near the lake.



Global distribution of the “Lake Phelps” Killifish, Washington and Tyrrell counties, North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried August 02, 2013 and is based upon a sample size of 11 records. The northernmost and two central lake markers represent records with imprecise locality information rather than true capture points.

Habitat The “Lake Phelps” Killifish is common in shallow water along sandy to muddy shorelines, often in association with submerged or emergent vegetation (Shute et al. 1983).

Life History and Ecology – The ecology of the “Lake Phelps” Killifish has not been described. But it is assumed that, like the Waccamaw Killifish, it is an epibenthic species, spending most of its time near the bottom, and seems to be an opportunistic feeder consuming primarily benthic chironomid larvae and amphipods (Lindquist and Yarbrough 1982). It is also assumed that spawning occurs from April through August; that males defend territories with lateral displays and spawn with passing females on silty substrate; and that adult females contain about 30 to 50 mature eggs (Shute et al. 1983).

Rationale for Designation - Lake Phelps is supplementally classified as Outstanding Resource Waters by the North Carolina Division of Water Quality. The shallow littoral zone used for spawning by “Lake Phelps” Killifish was damaged in the 1960s and 1970s by large amounts of wind-blown silt from extensive lands cleared for row crop agriculture in the area (Bailey 1977; Menhinick 1987; Menhinick and Braswell 1997). The lake has also been partially drained repeatedly for fire-fighting. The “Lake Phelps” Killifish is assigned State Threatened status.

Recommendations - Special attention should be given to preventing siltation in Lake Phelps and maintaining adequate water levels in Lake Phelps. A lake level management strategy involving use and

maintenance of the existing canal system was proposed and adopted in 1980 to reduce flooding frequencies and durations of the nearby agricultural areas (NCDNR&CD 1980). Lake Phelps receives partial protection because the entire lake is part of North Carolina's Pettigrew State Park and the north and northeast shores lie within the park proper. The west and southwest shorelines are part of the US Fish & Wildlife Service's Pocosin Lakes National Wildlife Refuge. This extent of public ownership should facilitate habitat protection and restoration activities. Further genetic studies of the "Lake Phelps" Killifish, Waccamaw Killifish, and nearby populations of the Banded Killifish are needed to resolve the systematic and taxonomic questions of this group. Life history and ecological studies of the "Lake Phelps" Killifish should also be undertaken. The NCWRC currently does not have any immediate work plans to further investigate this species. When last surveyed in 2010, "they were rather abundant" (pers. com. Mr. Tyler Black, NCWRC, August 09, 2013).

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North Carolina's Imperiled Fish Fauna, Part XIV
Submitted by Bryn H. Tracy, Wayne C. Starnes, and Stephen J. Fraley
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2013 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 14th of 16 planned articles on the species that the Council believes have become more imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Blackbanded Darter, *Percina nigrofasciata* (Agassiz)
Current Status: Threatened, Proposed Status: Special Concern



Photograph by Fred (Fritz) C. Rohde, courtesy of the Southeastern Fishes Council, <http://www.sefishescouncil.org/>.

Description - This is a medium-large darter, attaining total lengths of over 100 mm. Its ground color is straw yellowish to tan, paler on the belly. The sides have about 11 primary black blotches, which become vertically elongate in larger individuals and may resemble tall diamond-shapes anteriorly, with less intense secondary blotches between. Three spots are found at the base of the caudal fin and one is found at the base of the pectoral fin. The fins have specks on their membranes and large males have a dark basal band in their dorsal and anal fins. The body color can be highly variable and it is probably influenced by habitat. Fish taken over light-color and sandy substrates tend to be light colored, while those found in darker habitats (in vegetation and debris, for example) are overall darker and with accentuated barring patterns (Rohde et al. 2009). Breeding males darken overall and developed a blue wash over the body and a brownish-gold color on the head (Rohde et al. 2009). Lateral-line scales number 46-71 (Crawford 1956); 14 specimens at NCSM (NCSM Catalogue Nos. 30880, 30881, 65064, and 65071) had lateral line scale counts ranging from 58-68. The dorsal fin usually has 11-13 spines and 10-14 soft rays, the anal-fin rays number modally 9, and the pectoral-fin rays number 13-15. Males have ridge-like swellings on the anal and pelvic fin rays (Etnier and Starnes 1993). It is the only species of *Percina* in the Savannah River system in North Carolina.

Type Specimen and Type Locality - The Blackbanded Darter was described by Louis Agassiz in 1854 based upon an unknown number of specimens collected by Albert Stein, Esq. in April 1853 from the neighborhood of Mobile, Alabama (Agassiz 1854; <http://mczbase.mcz.harvard.edu/guid/MCZ:lch:24603>). The lectotype (a male, 103 mm SL) is at Harvard University's Museum of Comparative Zoology (MCZ Catalogue No. 24603; <http://mczbase.mcz.harvard.edu/guid/MCZ:lch:24603>; Collette and Knapp 1966).

Range -- The Blackbanded Darter is known on the south Atlantic Slope from the Edisto River of South Carolina southward to almost Lake Okeechobee in Florida and westward to the eastern tributaries of the Mississippi River in southwestern Mississippi (Crawford 1956; Etnier and Starnes 1993). It also occurs in the Cumberland Plateau, Piedmont and Ridge and Valley provinces in the Tombigbee, Alabama, Apalachicola, Savannah, and Edisto River systems (Burgess 1980).

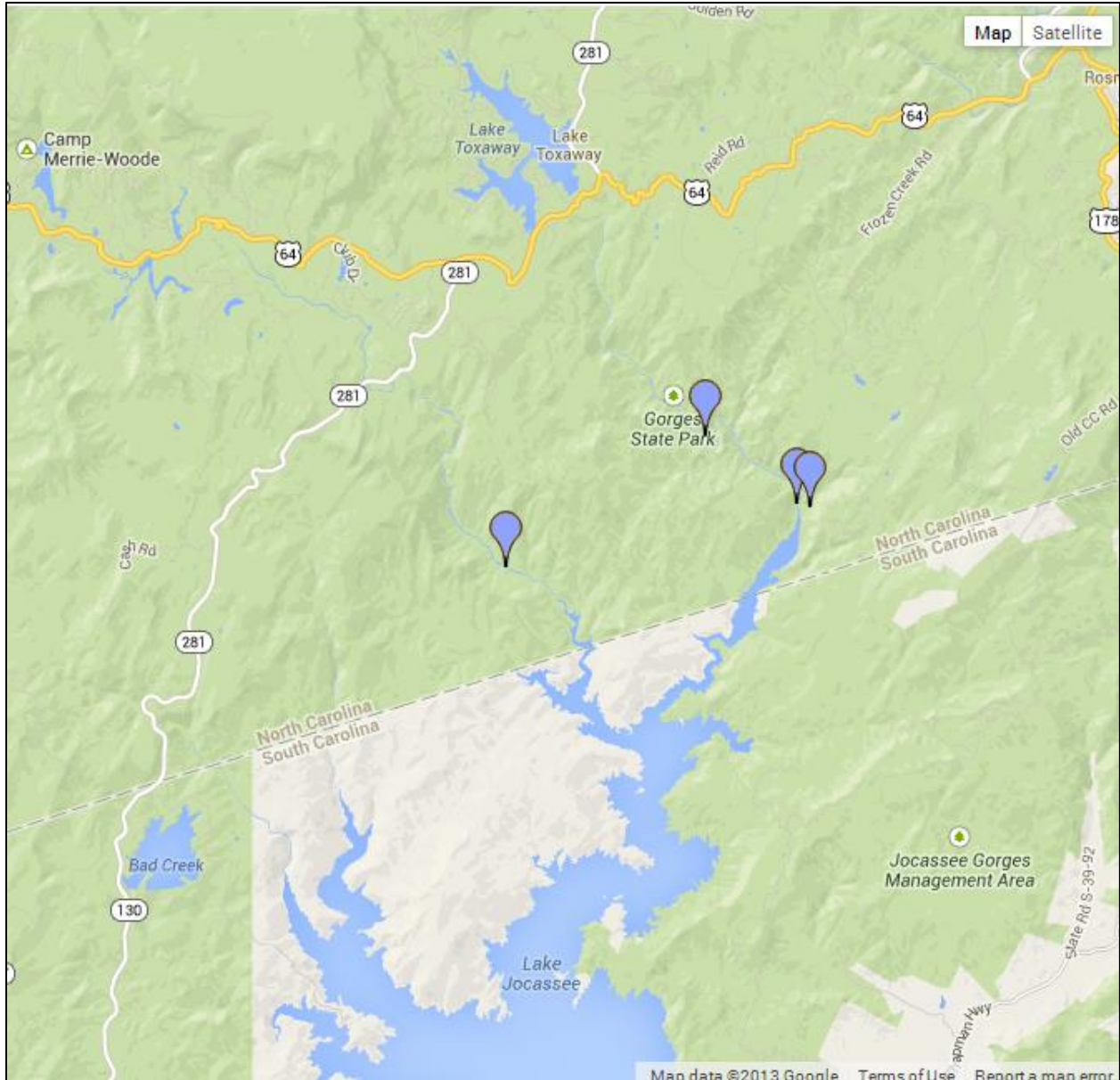
Previously unknown from North Carolina, the Blackbanded Darter was never-the-less included in Menhinick (1991) because of its known occurrence in tributaries to the Savannah River (i.e., Horsepasture, Toxaway, Whitewater, Chattooga, and Thompson rivers) just across the state line in South Carolina and Georgia (Crawford 1956; Burgess 1980). The first specimen from North Carolina was collected by Hugh Barwick (Duke Energy) on September 19, 1993 from the lower reaches of Toxaway Creek just before entering Lake Jocassee in Transylvania County. The single specimen (102 mm TL) resides in the Duke Energy collection (Catalogue No. 2137) (pers. com. Dave Coughlan, April 07, 2006 and Mike Abney, November 01, 2013). Additional specimens were collected in 2000 from the Toxaway River and Toxaway Creek (NCSM 30880 and 30881) and in 2010 from the Horsepasture and Toxaway rivers (NCSM Catalogue Nos. 65064 and 65071) and Toxaway Creek (10 specimens observed, none preserved, NCWRC Aquatics Database, queried November 07, 2013). In 2001, Blackbanded Darter was also collected, but not preserved, from Rock Creek near its confluence with the Toxaway River (Lake Jocassee) (Robinson and Rand 2002). It has never been collected from the other major Savannah River Basin tributaries in North Carolina (i.e., Chattooga, Whitewater, and Thompson rivers).

Habitat -- This darter inhabits creeks, moderate sized rivers, and reservoirs, ranging from Blue Ridge to Coastal Plain. It prefers areas of moderate current and is found over a variety of substrate types, ranging from silty sand or gravel to rock, and is often associated with woody debris or heavy vegetation such as waterwillow, *Justicia* spp. (Etnier and Starnes 1993; Rohde et al. 2009).

Life History and Ecology -- The diet consists of microcrustaceans and aquatic insects-dominated by dipteran and caddisfly larvae and mayfly nymphs. Spawning occurs April to June. Females may contain up to 250 eggs. Its lifespan is 3-4 years or more (Mathur 1973a, 1973b; Etnier and Starnes 1993).

Rationale for Designation - Like the similarly distributed Turquoise Darter, *Etheostoma inscriptum* (a state Threatened species), the Blackbanded Darter is a rare element of North Carolina's biodiversity and a hallmark of a distinctive Savannah Basin fauna, which barely enters the state's borders. The North Carolina populations are separated from downstream populations in South Carolina and Georgia by Jocassee Dam and Reservoir. For these reasons, the species was proposed as state Threatened in 2005 with a state ranking of S1 (critically imperiled due to extreme rarity or some factor(s) making it especially vulnerable to extirpation (local extinction) from the state; typically five or fewer occurrences or very few remaining individuals (<1.000)). This recommendation was adopted by 2008 (LeGrand et al. 2008).

Given that the Blackbanded Darter's habitat enjoys some protection due to being situated in the new North Carolina Gorges State Park; that the species seems to demonstrate some tolerance of impoundments (probably in adult phases); that populations exist downstream in South Carolina (albeit fragmented by the dam); and that the NC Division of Water Resources has supplementally classified portions of the Whitewater River as High Quality Waters, portions of the Horsepasture River as Outstanding Resource Waters, and most of the waters as Trout waters, the status of State Special Concern seems most befitting, rather than Threatened. Globally, the species is regarded as stable (secure) (Warren et al. 2000; LeGrand et al. 2012).



Distribution of the Blackbanded Darter in Transylvania County, North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried October 30, 2013 and is based upon a sample size of four records.

Recommendations – Tributaries to the Savannah River in North Carolina should be periodically monitored to determine the status and range of this and other species (e.g., Turquoise Darter and Rosyface Chub, *Hybopsis rubifrons*) restricted to that system within the state's borders. The NCWRC periodically (approximately five year intervals) samples a number of long-term monitoring sites on tributaries in the Savannah River Basin. Protection of these species should figure prominently into any plans for development of the area.

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North Carolina's Imperiled Fish Fauna, Part XV
Submitted by Bryn H. Tracy and Fred (Fritz) C. Rohde
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2013 newsletters, there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15 member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 15th of 16 planned articles on the species that the Council believes have become more or less imperiled since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Riverweed Darter, *Etheostoma podostemone* Jordan and Jenkins
Current Status: Special Concern, Proposed Status: Delist



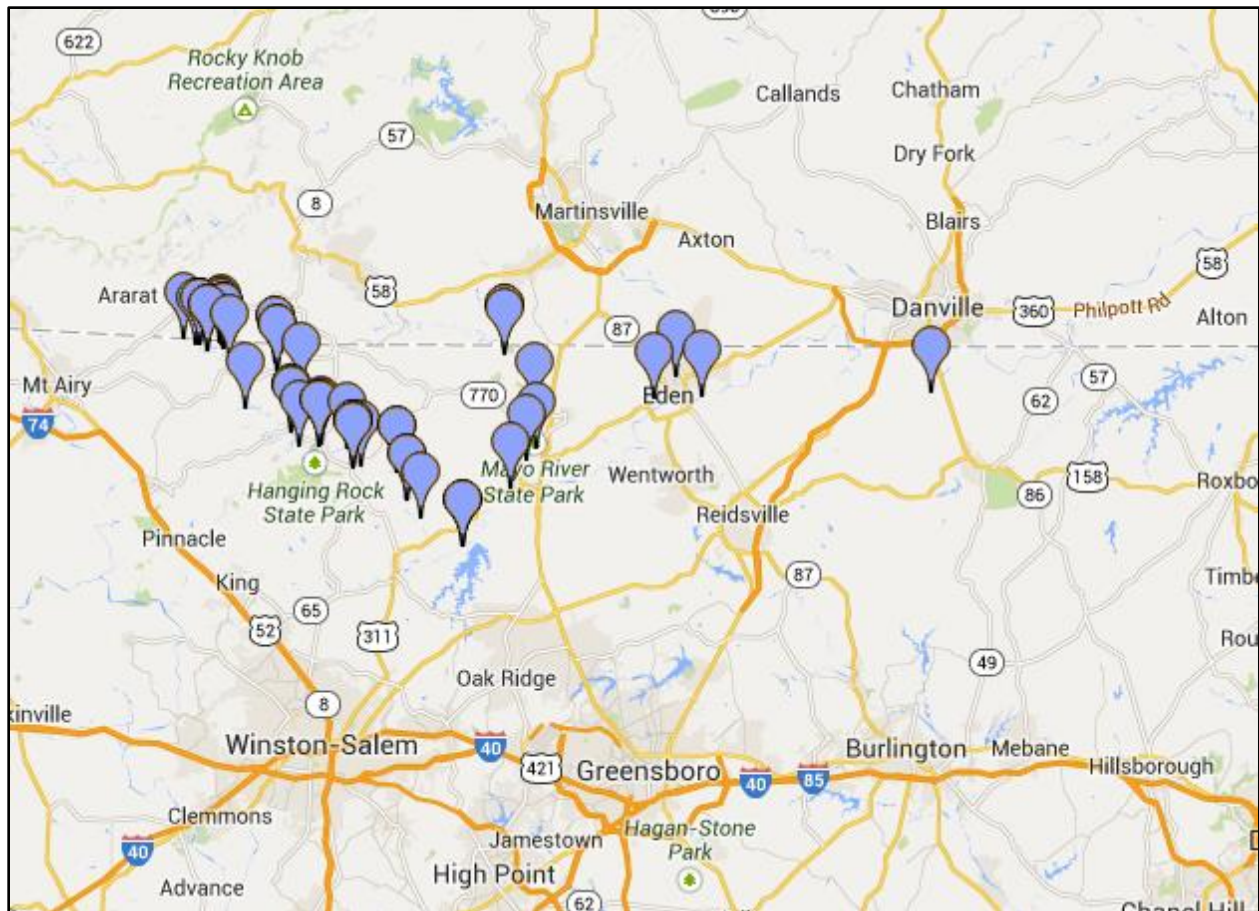
Photograph by Noel Burkhead and Robert Jenkins, courtesy of the Southeastern Fishes Council, <http://www.sefishescouncil.org/>.

Description – From Jenkins and Burkhead (1994): “A laterally XW-marked or evenly spotted darter; adults are 30-55 mm SL. Body elongate or somewhat moderate; snout blunt; frenum absent; branchiostegal membranes moderately or broadly united; caudal fin truncate or rounded; dorsal fins high and caudal very rounded in adult males. Opercle usually 50-80% scaled; belly usually 50-60% scaled; cheek, nape, and breast naked.” Possibly confused with the syntopic Johnny Darter, *Etheostoma nigrum*, however the Riverweed Darter has gill membranes which are broadly joined, 100-110° angle, vs. having the gill membranes narrowly joined, 55-75° angle (Menhinick 1991). Other characteristics that can be used to differentiate the two species are the infraorbital canal (uninterrupted in Riverweed Darter vs. usually interrupted in Johnny Darter) and the number of anal spines (usually 2 in Riverweed Darter and 1 in Johnny Darter) (Jenkins and Burkhead 1994).

Type Specimen and Type Locality - The Riverweed Darter was described by David Starr Jordan and Oliver P. Jenkins in 1889 based upon an unknown number of specimens collected in 1888 by Jordan, Jenkins, and Barton W. Evermann from the Roanoke River at Roanoke, Salem, and Alleghany Springs, VA (Jordan 1889). A 45-mm SL male specimen from the Roanoke River at Alleghany Springs, Montgomery County, VA has been designated as the lectotype (Collette and Knapp 1966; National Museum of Natural History Catalogue Number USNM 39863; <http://collections.mnh.si.edu/search/fishes/>). Its specific name was given because of its association with an aquatic macrophyte known as River Weed, *Podostemum ceratophyllum*. They found the darters to be especially plentiful in the clear waters of

Bottom Creek, a headwater tributary to the Roanoke River, about five miles above Alleghany Springs, VA (Jordan 1889).

Range – The Riverweed Darter is endemic to the upper and middle Roanoke River drainage in Virginia and the more southern Dan River system in Virginia and North Carolina (Jenkins 1980; Jenkins and Burkhead 1994). In North Carolina, it is restricted to the Dan River subsystem including the Mayo, Little Dan, and Smith rivers and to medium-sized tributaries such as Archies, Big, Big Beaver Island, Buffalo, Cascade, Country Line, Elk, Hogans, Indian, Little Beaver Island, Matrimony, North Double, Peters, and Snow creeks in Stokes, Rockingham, and Caswell counties (Menhinick 1991; databases of the NC Division of Water Resources, North Carolina State Museum of Natural Sciences, and NC Wildlife Resources Commission, queried January 08, 2014). Rohde et al. (1998) found it in a 124 river kilometer section of the Dan River in North Carolina between July 1992 and May 1995 as well as in the Little Dan, Mayo, and Dan rivers upstream in Virginia. It was most abundant in the mainstem of the Dan River between river kilometer 207 and 259 in the Inner Piedmont portion of the river (Rohde et al. 2003).



Distribution of the Riverweed Darter in the Roanoke River system, North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried January 08, 2014 and is based upon a sample size of 54 records.

Habitat – In 1888, the Riverweed Darter abounded in swift water, especially among rocks covered with Riverweed (*Podostemum ceratophyllum*) (Jordan 1889). Across its range, the darter occupies cool and warm, moderate-gradient creeks, streams, and rivers. Adults typically associate with clean loose medium gravel, rubble, and small boulders; young associate with these substrate and often with sand and slightly silted areas (Jenkins and Burkhead 1994).

Life History and Ecology – Sexual maturity in the Riverweed Darter is reached in 1 or 2 years; maximum longevity is 4 years (Jenkins and Burkhead 1994). In aquaria, spawning occurred from late March to late May when water temperatures were 17-20°C (Jenkins and Burkhead 1994). Adhesive eggs are laid on the underside of stones by several females and guarded by a territorial male until hatching (approximately 13 days). The Riverweed Darter feeds primarily on chironomid larvae with feeding activity greatest during daylight (Jenkins and Burkhead 1994; Matthews et al. 1982).

Rationale for Designation –The Riverweed Darter was listed as a Special Concern species by the Committee in 1977 because of the proposed construction of a dam on the Dan River and because it was believed to be restricted to larger waters of a limited region (Menhinick 1987; Menhinick and Braswell 1995; Harris et al. 2010). The dam was never built, but the species continued to be listed as Special Concern, primarily because of the perceived lack of additional distributional data. Rohde (1993) recommended that the species be delisted because in 1992 it was widely distributed in the Dan River subsystem in North Carolina, it occurred in good numbers, and the presence of four other rarer species: Cutlip Minnow, *Exoglossum maxillingua*, Special Concern; Rustyside Sucker, *Thoburnia hamiltoni*, State Endangered; Bigeye Jumprock, *Moxostoma ariommum*, State Threatened; and Orange-fin Madtom, *Noturus gilberti*, State Endangered, would provide continued protection for this portion of the Dan River subsystem. Riverweed Darter was considered secure in North Carolina by Rohde, et al. (1998).

Additional data indicate populations are strong in the Smith and upper Dan rivers and their tributaries and are at levels for which there is no reason to continue listing the species (Harris et al. 2010). The NCWRC's Scientific Council of Fishes recommended in 2010 that the species be delisted. However, until legislative action is taken, the Riverweed Darter continues to be listed as Special Concern (LeGrand et al. 2012).

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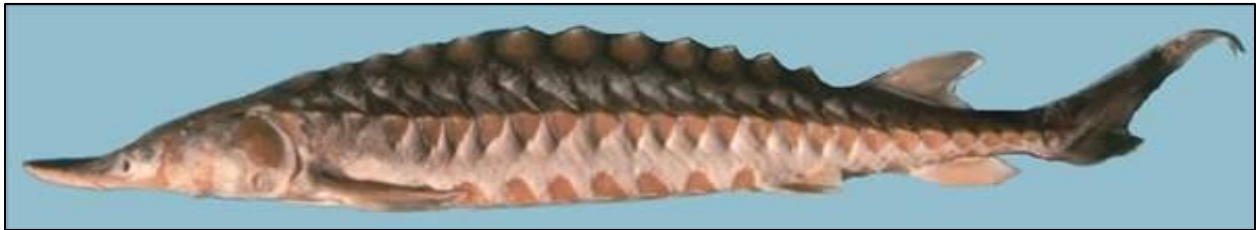
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North Carolina's Imperiled Fish Fauna, Part XVI
Submitted by Bryn H. Tracy
on behalf of the NCWRC's Scientific Council of Fishes

As mentioned in the Chapter's 2010-2014 newsletters (<http://www.sdafs.org/ncafs/content.html?contentName=newsletters>), there are approximately 215 indigenous, described, and undescribed species of strictly freshwater fishes in North Carolina. Of these, 26% are state or federally listed: Endangered (17), Threatened (17), or Special Concern (22) (Harris et al. 2010). It is the responsibility of the 15-member Scientific Council on Freshwater Fishes to submit its recommendations to the Nongame Advisory Committee of the North Carolina Wildlife Resources Commission (NCWRC) if changes in imperilment classifications for any species are warranted. To communicate our findings with the chapter membership, this is the 16th of 16 planned articles on the species that the Council believes have become more or less imperiled or changed status since the last listing in 2006. Thus acquainted, it is hoped that chapter members can serve as additional "eyes and ears" to expand our vigilance for these rare or highly localized fishes.

Atlantic Sturgeon, *Acipenser oxyrinchus* Mitchell
Current Status: Special Concern

Proposed Status: Delist (recommended by NCWRC's Scientific Council of Fishes, eff. 11/30/2010)
Proposed Status: Endangered (listed by National Marine Fisheries Service, eff. 04/06/2012)



Photograph by Fred (Fritz) C. Rohde

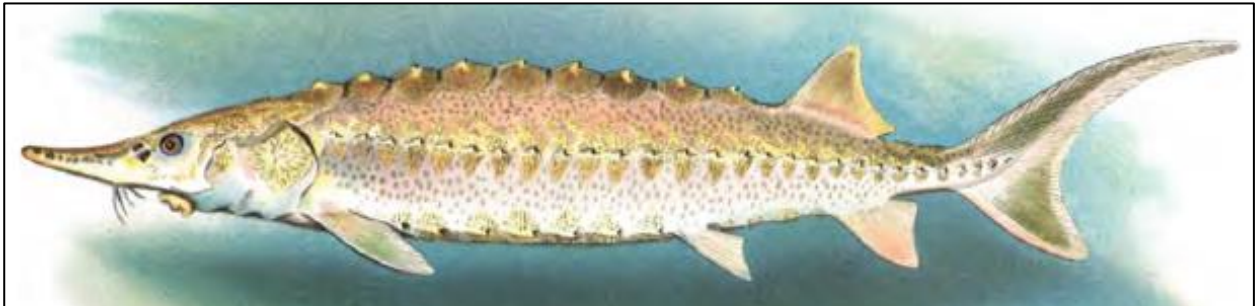


Illustration from Smith (1907)

Description – The Atlantic Sturgeon was described 200 years ago by Professor Samuel L. Mitchell (quoting verbatim):

"2. *Sharp-nosed Sturgeon. (Acipenser oxyrinchus)*. Having a pentagonal form, with scabrous asperities between the scales, and a sharp snout.

Agrees in many respects with the preceding species [Round-nosed Sturgeon, *Acipenser sturio*, my brackets]; having, like it, five sides and as many scaly angles. Whether the individuals as now under consideration, differ from the *A. sturio* merely in sex and age, has been made a question. But the dissimilitude of the *blunt*-nosed and *sharp*-nosed sturgeon, is very obvious. The mouth, nostrils, and eyes, are different.

The number of scales on the sharp-nosed sturgeon, is not so great as in the blunt-nosed. On all the angles they are less numerous. The skin is more scabrous. The asperities between the scales, are very distinct, and scratch the finger like a grater when moved along them, especially from tail to head. The points resemble the spiculæ of minute crystals, occupying much of the space between the scales.

The scales themselves are bony, rough, and serrated behinds, and very distinct in their configuration. There are four scales between the vent and the anal fin; the two foremost of which make a pair; and four more between the anal fin and the tail, the two foremost of which lap over the base of that fin in some measure, and support it. But sometimes there are more, and at other times fewer.

There is osseous matter on the sides of the snout, and a strip of the same beneath it, reaching from the tip toward the mouth.

The boys remark, that the gristle taken from the sharp-nosed sturgeon, is much less elastic than that of the blunt-snouted, and that a ball made of it does not bounce so well.

Grows seldom to greater than five feet. Is found in the Hudson plentifully, in the neighbourhood of Albany. My friend Simeon De Witt, Esq. informs me, "they are every year brought to the market of that city, under the name of *young* sturgeon. I suspect them to be of a different species, for two reasons. 1. Because there is no intermediate size between the largest of these and the smallest of the common sturgeon; and 2. The females of the smaller sort are filled with spawn" (Mitchell 1815, pages 462 and 463).

Easily confused with the Shortnose Sturgeon, *A. brevirostrum*, the Atlantic Sturgeon has scutes between the anal fin and the midlateral scutes, and the body cavity lining and intestine are pale. It also has an inner gape width of its mouth that is less than 60% of the interorbital width (Rohde et al. 2009). The Shortnose Sturgeon has no bony plates between the anal fin and the midlateral scutes, the lining of the body cavity and the intestine are dark, and the inner gape width is usually more than 62% of the interorbital width. Other characteristics for differentiating the two species are in the relative length of the snout, in the number of dermal scale rows between the pelvic and anal fin, and in the anal fin ray count (Menhinick 1991; Jenkins and Burkhead 1994). However, identification to species can be difficult, primarily because sturgeon morphology changes with age. Some previously published key characteristics are now known to be unreliable; for example, both coloration and pre-anal shield patterns can vary, and snout length changes with age. The only reliable means of identification (except for sheer size in the case of Atlantic Sturgeon) appears to be the mouth width:interorbital width ratio (Collins 2010).

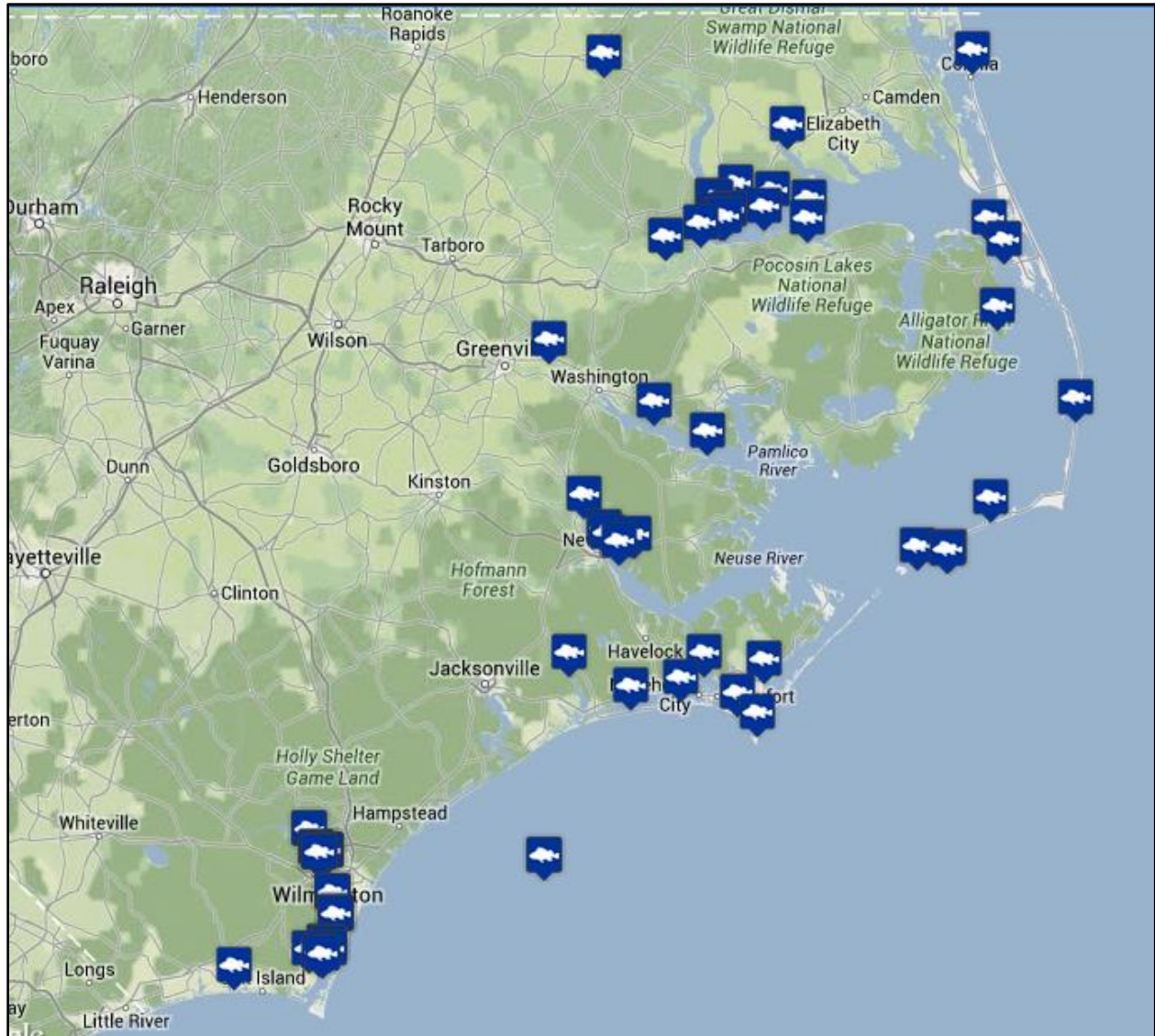
Type Specimen and Type Locality -- The Atlantic Sturgeon was described in 1815 based upon an unknown number of specimens collected from perhaps the Hudson River near Albany, NY and given the common name "Sharp-nosed Sturgeon" (Mitchell 1815). No type specimens are known (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>) and a neotype has not been designated, perhaps because no one has believed it is necessary to designate one (W. C. Starnes, pers. com., April 09, 2014).

The genus name *Acipenser* Linnaeus 1758 is Latin for sturgeon, derived from *akis*, point and *pente*, five, referring to five rows of body scutes. Its specific epithet *Acipenser oxyrinchus* is derived from *oxy*, meaning sharp and *rhynchus* meaning snout, referring to the sharply V-shaped snout (<http://www.etyfish.org/acipenseriformes/>). This spelling of the specific name, *A. oxyrinchus* (versus *A. oxyrhynchus*) is the one used in the original species description by Mitchell (1815) and thus, by the rule of original orthography, the correct one (Nelson, et al. 2004). No longer referred to as the Sharp-nosed Sturgeon, the American Fisheries Society's accepted common name is Atlantic Sturgeon (Nelson, et al. 2004).

Range – There are two allopatric subspecies of *A. oxyrinchus*: *A. o. oxyrinchus*, the Atlantic Sturgeon, and *A. o. desotoi*, the Gulf Sturgeon. As its common name implies, the Atlantic Sturgeon is found near shore and in coastal rivers from Hamilton Inlet, Labrador to the St. Johns River in northeastern Florida (Gruchy and Parker 1980). The Gulf Sturgeon is confined to the northeastern Gulf of Mexico, where it ranges from the Mississippi River delta in Louisiana eastward to the Suwannee River and Tampa Bay in Florida.

In North Carolina, the anadromous migratory Atlantic Sturgeon is found in large coastal rivers (e.g., Chowan, Roanoke, Tar, Neuse, White Oak, and Cape Fear), estuaries, and near shore from the Virginia to the South Carolina state lines (Menhinick 1991). Inland, it has been found as far upstream as the Town of Weldon on the Roanoke River (Northampton and Halifax counties) and near the City of Rockingham on the Pee Dee River (Anson and Richmond counties; Menhinick 1991). Historically, their migrations went further upstream, but have been blocked for many decades by the construction of dams

near the Fall Zone (e.g., Roanoke Rapids and Blewett Falls dams) or by the construction of navigational locks (e.g., on the lower Cape Fear River).



Distribution of the Atlantic Sturgeon in North Carolina. Map is based upon material vouchered and databased at the North Carolina State Museum of Natural Sciences; the database was queried March 07, 2014 and is based upon a sample size of 81 records.

Habitat – With its inferior protrusible mouth, this bottom-oriented species feeds in soft substrates but sexually mature adults, returning from marine coastal waters, may require hard clay, rubble, or gravel bottoms in well-oxygenated water for spawning (Ross et al. 1988). Juveniles may spend several years continuously in freshwater, but may move downstream to brackish waters as temperature decreases in the fall (Jenkins and Burkhead 1994).

Life History and Ecology – Atlantic Sturgeon are slow-growing, long-lived, and late-maturing fishes. It is the longest-living, largest, and heaviest freshwater species in North Carolina. However, specimens larger than 2 m are now uncommon in North Carolina (Ross et al. 1988). The Atlantic Sturgeon feeds opportunistically on soft bottoms, ingesting benthic crustaceans, mollusks, annelids, small fishes, vegetation, and aquatic insects (Ross et al. 1988). The sexes are externally indistinguishable except during the spawning season when females are swollen with roe (Jenkins and Burkhead 1994). Adults

tend to spawn at intervals of several years; the intervals (the period between successive spawnings) seem to increase with age (Jenkins and Burkhead 1994). The species is anadromous ascending from the Atlantic Ocean, estuaries, or sounds into the coastal rivers to spawn as early as February with peak spawning in March or April (Ross et al. 1988). However, a small fall spawning population has been recently documented by the collection of fertilized eggs in 2012 in the Roanoke River near Weldon, NC by staff from North Carolina State University, the North Carolina Wildlife Resources Commission, and the North Carolina Division of Marine Fisheries (Miller 2013). Vital parameters of sturgeon populations show latitudinal variation with faster growth and earlier age at maturation in more southern systems, though not all data sets conform to this trend

(http://www.nmfs.noaa.gov/pr/pdfs/species/atlanticsturgeon_detailed.pdf). Fecundity is correlated with age and body size with the average age at which 50% of maximum lifetime egg production is achieved estimated to be 29 years, approximately 3 to 10 times longer than for other bony fish species examined (http://www.nmfs.noaa.gov/pr/pdfs/species/atlanticsturgeon_detailed.pdf; Boreman 1997).

According to Dr. Timothy King (U. S. Geological Survey, Leetown Science Center, Kearneysville, WV), presently there are at least five evolutionarily distinct lineages of Atlantic Sturgeon inhabiting the U.S. Atlantic coast based on the presence of at least four zones of genetic discontinuity. Demonstration of a shallow mitochondrial genealogy combined with preliminary coalescence-based historical demographic analyses suggests that in the past, population sizes must have been sufficiently large to allow gene exchange (e.g., straying) to occur among adjacent populations. In other words, the limited metapopulation structuring that appears to exist now in the Gulf of Maine, New York Bight, and the Southeast, likely existed throughout the species range. Given the apparent recency of the regional genetic differentiation that exists among contemporary populations, a long-term management goal should be to re-establish populations of sufficient size that gene exchange can again occur among adjacent river systems. This type of metapopulation structure is the best defense against extirpation and extinction (King 2013; pers. com. April 30, 2014).

Rationale for Designation – There are many causes for the decline of this species in North Carolina: overfishing, bycatch, ship strikes, water quality and habitat degradation, and the construction of navigational locks and hydroelectric and flood-control dams. Because of the species' slow growth and maturation (up to 30 years) and relatively long periods between spawnings, sturgeon populations were relatively easily overfished and have been slow to recover (Jenkins and Burkhead 1994; <http://www.ncwildlife.org/portals/0/Fishing/documents/atlsturg1.pdf>).

Three hundred years ago, John Lawson in 1709 reported: "*In May, they [sturgeon, which may have been either Shortnose Sturgeon or Atlantic Sturgeon] run up towards the Heads of the Rivers, where you see several hundreds of them in one day*" (Lawson 1709 and cited in Smith 1907). Two hundred years later, Smith (1907) reported that: "*This species is now much less abundant than formerly, and in North Carolina has undergone the same diminution seen in other states. Whereas it was formerly regarded as a nuisance, and ruthlessly destroyed and thrown away whenever caught, it is now one of the most valuable of the east coast fishes*". Smith (1907) continues: "*In some of the large shad seines in Albemarle Sound it has sometimes happened during the past seven or eight years that not a single adult sturgeon has been caught during an entire season whereas 20 years ago sturgeon were abundant here and each season the shores were covered with dead fish for which there was no sale. Then the fishermen finally realized the value of the fish, they pursued the fishery so actively that the species was almost wiped out in a short time and has never been able to reestablish itself*". Smith (1907) considered the Atlantic Sturgeon to be: "*by far the most valuable fish, individually considered, inhabiting the waters of North Carolina or, in fact, the Atlantic coast of the United States*". Because of this: "*It is incumbent on the state to take prompt and radical measures to prevent the further diminution in the supply of this excellent fish and to restore it to something like its original abundance, if this is now possible. Besides prohibiting absolutely the killing of any example under 3 feet long, it will probably be desirable to stop the destruction of large fish for a term of years. Supplementary to these restrictive aids, the state of the general government should undertake the artificial propagation of the sturgeon on several of the rivers where the fish is still found*".

In North Carolina, the Atlantic Sturgeon has been listed as a Special Concern species since 1977 (Cooper et al. 1977; LeGrand et al. 2012). However, Menhinick (1987) believed that the species was especially common in the lower Cape Fear River and with its wide distribution, warranted no special status. He proposed that it should be delisted due to range extensions and to re-identifications of records of Shortnose Sturgeon as Atlantic Sturgeon. However, there were also misidentifications of Shortnose Sturgeon as Atlantic Sturgeon, so the misidentifications have gone in both directions.

In 2010, the NCWRC's Scientific Council of Fishes recommended that the species be delisted, not because the species is no longer in need of protection, but rather because the Council believed the North Carolina General Statutes §113-331 to §113-334 that govern listing of animals were unclear on the listing of diadromous fishes. Animals that depend on coastal waters for a part of their life cycle are excluded from the animals that the NCWRC can list. The Committee sought a legal opinion from NCWRC's Counsel to determine if such species can be listed at all, listed only in inland waters by the NCWRC, or listed only in inland waters by the NCWRC with the concurrence of the Marine Fisheries Commission. According to Fred Harris (pers. com. April 29, 2014), NCWRC Counsel advised that the NCWRC could list the Atlantic Sturgeon in inland and coastal waters with the concurrence of the North Carolina Division of Marine Fisheries. But, without such concurrence, NCWRC could list the Atlantic Sturgeon in inland waters only. NCWRC Counsel and NCWRC believed concurrence was unlikely and listing in inland waters only would not be particularly effective and would be confusing to most people. The Council's recommendation to delist the Atlantic Sturgeon on a legal technicality did not proceed any further and the species remained listed as Special Concern at the state level.

However, at the federal level, the Carolina distinct population of Atlantic Sturgeon (*A. o. oxyrinchus*) was listed on February 06, 2012, with an effective date of April 06, 2012, by the National Marine Fisheries Service as endangered under the Endangered Species Act (<http://www.nmfs.noaa.gov/pr/pdfs/fr/fr77-5914.pdf>). According to North Carolina General Statute §113-334(a), all native or resident wild animals which are on the federal list of endangered or threatened species pursuant to the Endangered Species Act have the same status on the North Carolina protected animals lists. Thus, the Atlantic Sturgeon must now also be listed as endangered at the state level.

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ADDENDUM

In 2012, North Carolina Wildlife Resources staff reviewed the recommendations that had been made by the Scientific Council on Freshwater Fishes and which had been submitted to the North Carolina Nongame Advisory Committee. NCWRC staff largely supported the Council's recommendations (e-mail from Dr. David Webster to Dr. Michael Dorcas with Cc to Mr. Fred Harris, et al., dated September 24, 2014 and forwarded to Mr. Bryn Tracy on September 24, 2014). However, there were four instances where the Council's recommendations were not supported by NCWRC staff and who did not find probable merit for changing the listings. The NCWRC staff concluded:

1. American Brook Lamprey, *Lampetra appendix*
Explanation: This species is currently listed as Threatened. This species is common throughout its range. North Carolina is on the southern boundary of its range, which barely enters into NC. WRC staff recommend that status should remain as threatened. Council recommend that the fish be uplisted to endangered.
2. Mountain Madtom, *Noturus eleutherus*
Explanation: This species is currently listed as Special Concern. This species is common throughout its range. North Carolina is on the boundary of its range. It was recently rediscovered in NC, with high density where found. WRC staff recommend leaving as special concern. Council recommend that the fish be uplisted to endangered.
3. Tennessee Darter, *Etheostoma tennesseense*
Explanation: This species is currently listed as Special Concern. It was not recognized as a species until 2007 (split from another species) and has no NatureServe or IUCN designation. It is found in Shut In Creek (near TN line). WRC staff recommend leaving as special concern. Council recommend that the fish be uplisted to endangered.
4. "Thinlip" Chub, *Cyprinella* sp. cf. *zanema*
Explanation: This species is currently listed as Special Concern. This species appears to be doing well in the Lumber River. WRC staff recommend keeping at special concern based on new data from the Lumber River and pending more surveys in other river systems. Council recommend uplisting to threatened.

As of November 01, 2014, none of the recommendations proposed by the Council in 2010 or by the NCWRC staff in 2012 have been acted upon by the North Carolina Wildlife Resources Commissioners.