

FIRST REPORT OF ROBUST REDHORSE *MOXOSTOMA ROBUSTUM* SERVING AS HOST FOR SEA LAMPREY *PETROMYZON MARINUS*



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INTRODUCTION

Research on the distribution, population size, habitat preferences, and tissue contaminants of Robust Redhorse *Moxostoma robustum* in North Carolina has been conducted since the early 2000s. During this time, researchers have sporadically recorded generic wounds that have been observed on Robust Redhorse, most attributable to spawning-related activity or the occasional Otter attack, but the researchers have never observed wounds specifically attributed to Sea Lamprey *Petromyzon marinus*. Here we provide evidence of the first observations of three Robust Redhorse serving as hosts for Sea Lamprey.

Observations were made between late April and early May 2023 during the collection of ripe male and female Robust Redhorse in the Pee Dee River downstream from Blewett Falls Dam in an effort to augment and re-introduce at a future date their progeny back into the Pee Dee River. Efforts were organized by Brena Jones (North Carolina Wildlife Resources Commission [NCWRC]) with assistance from the staffs of Duke Energy, South Carolina Department of Natural Resources, NCWRC's McKinney Lake Fish Hatchery and Aquatic Wildlife Diversity Program, the South Carolina Aquarium, Todd Pusser, and Bryn H. Tracy. All fish collections were made with boat electrofishers.

BACKGROUND ON THE DISTRIBUTIONS OF SEA LAMPREY AND ROBUST REDHORSE IN NORTH CAROLINA

The Sea Lamprey (Figures 1 and 2) is an anadromous species, meaning it spawns in fresh water and juveniles and adults migrate downstream to marine environments to continue feeding and maturing before returning upstream to spawn. The larvae,

termed ammocoetes, are free swimming and are found buried in the silts and fines along the stream bank. The transformed juveniles and adults are parasitic, attaching to their host with their toothy and suction-like oral disc (Figure 3). Reported hosts in North Carolina include American Shad *Alosa sapidissima* and Hickory Shad *A. mediocris*.

In North Carolina, the Sea Lamprey is widely distributed in the Coastal Plain, where it has been documented from the Albemarle, Chowan, Roanoke, Tar, Neuse, Cape Fear, Shallotte, and Yadkin basins, as well as in the Atlantic Ocean (Map 1; Tracy et al. 2020). Ammocoetes and adults have been collected from the Yadkin-Pee Dee River drainage in smaller creeks in Anson County, such as Bailey, South Fork Jones, North Fork Jones, and Mill creeks. Although there are five species of lampreys in North Carolina, Sea Lamprey is the only species of found in the Yadkin-Pee Dee River drainage (Tracy et al. 2020).

In North Carolina, Robust Redhorse (Figure 4), a big-river species, is now only found only in the lower Yadkin-Pee Dee River drainage downstream from Blewett Falls Dam (Map 2). It was originally found in the Catawba River basin at Morganton in Burke County and in the Yadkin basin upstream into the South Yadkin River system (Hunting Creek) in Davie and Rowan counties and in the Yadkin River near Donnahana in Forsyth and Yadkin counties (Tracy et al. 2020). Its distribution in the lower Yadkin-Pee Dee River is sympatric with that of the Sea Lamprey (Maps 1 and 2).



Figure 1. Adult Sea Lamprey, 610 mm total length and 51 mm in circumference, netted in Bear Swamp, Halifax County, May 01, 2008, Tar River basin. Fish was captured by backpack shocking into a seine by Chris Eads, Megan McCormick, Sarah McCrae, Rob Nichols, Renee Greiner, and Chris Wood. (Photo by Rob Nichols)

Bryn H. Tracy was the project leader for the wadeable stream fish community assessment program. He has worked in the aquatic sciences field in North Carolina since 1983. His interests in retirement have continued to focus on the history and distribution of the state's indigenous freshwater fish fauna and on the introduction, dispersal, and impact of the ever-increasing list of nonindigenous species.

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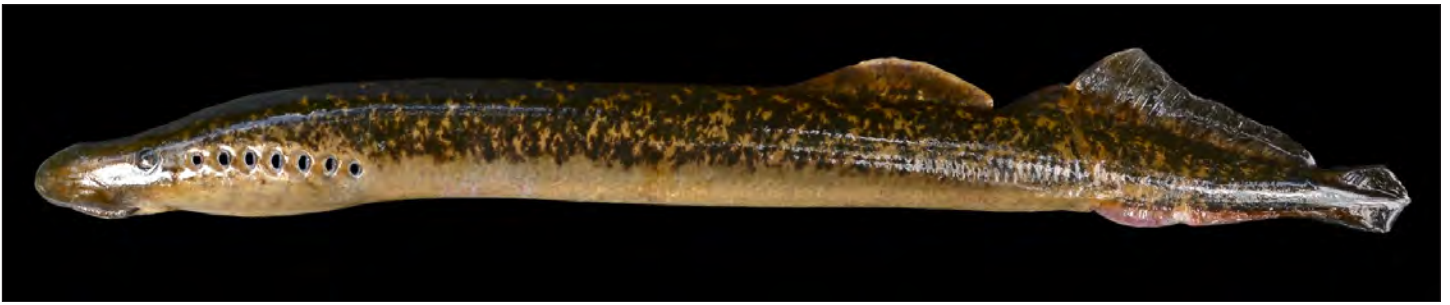
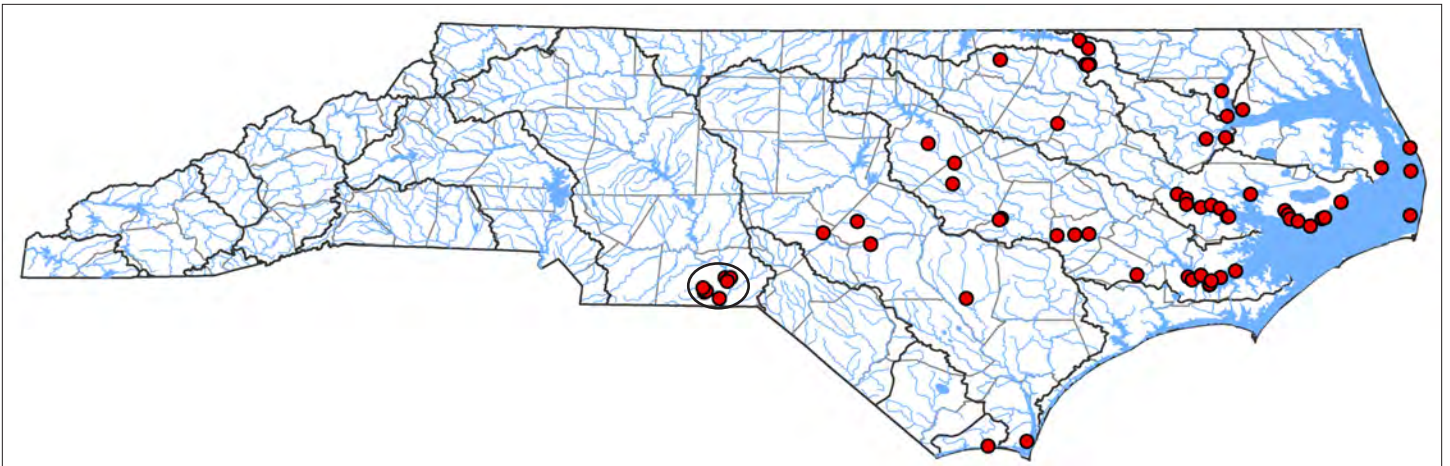
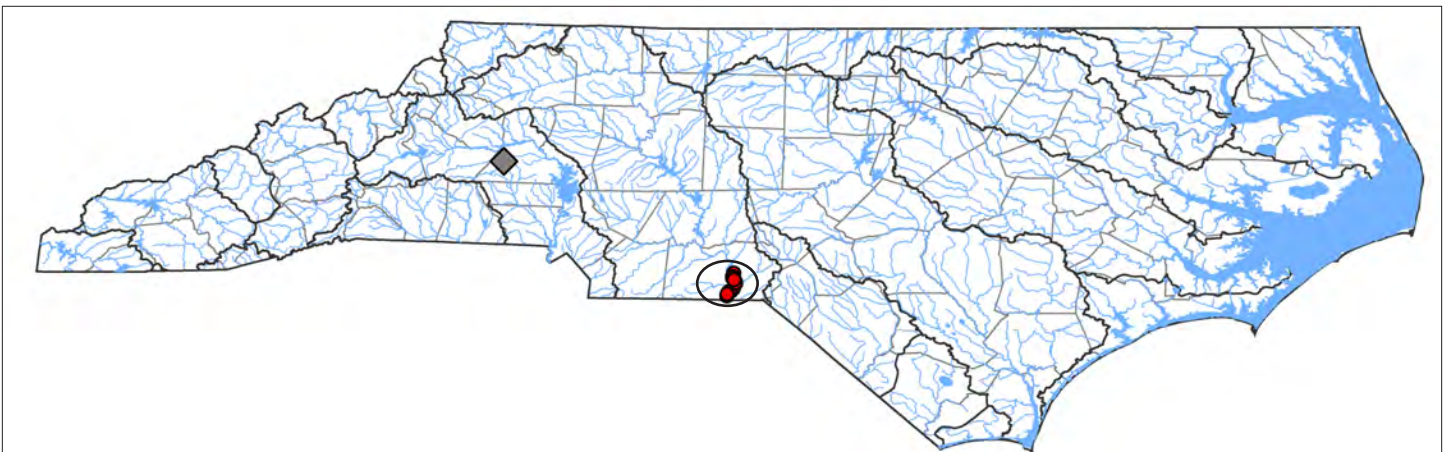


Figure 2. Adult Sea Lamprey. (Photo by Brian Zimmerman)



Map 1. Distribution of Sea Lamprey in North Carolina (Tracy et al. 2020). Records from the Yadkin-Pee Dee River drainage are enclosed within the black oval.



Map 2. Current distribution of Robust Redhorse in North Carolina. Gray diamond indicates presence in that basin (extirpated; no vouchered museum specimens) (Tracy et al. 2020). Records from the Yadkin-Pee Dee River drainage are enclosed within the black oval.

Table 1. Collections of Robust Redhorse from the Pee Dee River in North Carolina showing wounds made by Sea Lamprey.

| Fish ID No. | Sex | Total Length (mm) | Weight (g) | Age (yrs.) | Location | County | Location of Wound | Diameter of Wound (mm) |
|-------------|--------|-------------------|------------|------------|--|----------|-----------------------------------|------------------------|
| 43152D7D1C | Female | 692 | 4910 | 9 | Shoal just above US 74 | Richmond | Postero-medial to left pelvic fin | ~ 15 |
| 444317161A | Male | 635 | 3975 | 9 | Hitchcock Creek Shoal | Richmond | Antero-medial to right pelvic fin | Unknown |
| 486B0A4F0B | Female | 675 | 6065 | 9 | Side channel at Big Island, near the dam | Anson | Medial right caudal peduncle | ~ 10 |



Figure 3. Close-up of oral disk of Sea Lamprey. (Photo by Brian Zimmerman)



Figure 5. Female Robust Redhorse, Fish No. 43152D7D1C, showing wound made by Sea Lamprey. Top: whole body image; bottom: close-up of wound. (Photos by Brena K. Jones)



Figure 4. Adult male Robust Redhorse. (Photo by Scott A. Smith)

ROBUST REDHORSE SERVING AS HOST FOR SEA LAMPREY

In late April-early May 2023, three adult Robust Redhorse exhibited unusual wounds that differed from the abrasions, fin damage, and occasional punctures seen in the past (Table 1; Figures 5–7). After discussions amongst ourselves, we concluded that the wounds might have been caused by Sea Lamprey due to their characteristic shape and cleanly incised edges. However, without actual Sea Lamprey specimens that were attached to a fish for positive determinations, we had to rely on circumstantial evidence for this conclusion.

The images were verified as Sea Lamprey wounds by staff from National Oceanic and Atmospheric Administration's Maine Field Station (Jeff Murphy) and Maine's Department of Marine Resources (Mitch Simpson) who have years of experience in the identification of Sea Lamprey wounds (Fritz Rohde, personal communication). From Figure 6, Mitch reported to us that: "It looks like the lamprey originally attached above the pectorals and slid back before it could get good penetration. I've seen many fish with scars from lamprey that show how the lamprey moves (downstream [posteriorly]) before attaching securely."



Figure 6. Male Robust Redhorse, Fish No. 444317161A, showing wound made by Sea Lamprey. Top: whole body image; bottom: close-up of wound. (Photos by Brena K. Jones)

Despite years of surveys and research activities spanning many thousands of person-hours boat electrofishing the Pee Dee River in North Carolina and South Carolina or other big



Figure 7. Female Robust Redhorse, Fish No. 486B0A4F0B, showing wound made by Sea Lamprey. Top: whole body image; bottom: close-up of wound. (Photos by Vann Stancil)

ivers in in South Carolina and Georgia in search of Robust Redhorse, no Sea Lampreys have ever been reported from Robust Redhorse, either attached or evidence of existing wounds or healed scars. Lamprey parasitism may not kill the fish but may lead to secondary infections or overall poor health and condition of its host.

CONCLUSIONS

With the return and slow increase in population size of the Robust Redhorse to the Yadkin-Pee Dee River drainage, Sea Lampreys may have once again found another one of their ancestral hosts, besides American Shad, after surviving for more than 100 years on large, introduced species such as Blue Catfish *Ictalurus furcatus*, Channel Catfish *I. punctatus*, Smallmouth Buffalo *Ictiobus bubalus*, Common Carp *Cyprinus carpio*, and Grass Carp *Ctenopharyngodon idella*. With its long-lost host having a lifespan of more than 20 years, there will be plenty of time and opportunity for more observations by future researchers of Sea Lamprey attached to, or evidence of prior attachment to, Robust Redhorse in the Pee Dee River in North Carolina and South Carolina.

Reference

Tracy, B.H., F.C. Rohde, and G.M. Hogue. 2020. An annotated atlas of the freshwater fishes of North Carolina. Southeastern Fishes Council Proceedings. No. 60. Volume 1. 198pp.

FishMap.org

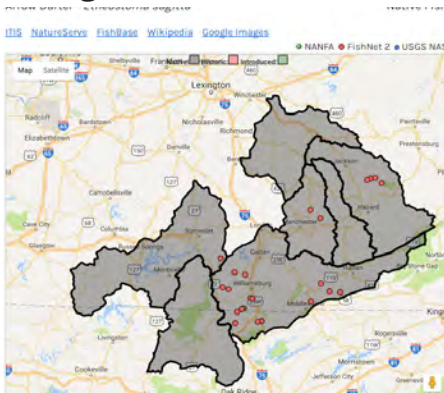


FishMap.org is for anglers, aquarium hobbyists, scientific researchers, or anyone else with a passion for fishes who wants to visually explore species' ranges or learn what species are in their local waters. The site is dedicated to spreading knowledge and respect for all fish species.

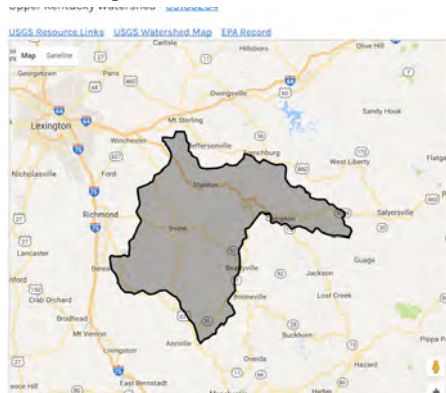
FishMap.org combines numerous data sources to provide a better view and more complete understanding of fish species distribution. It uses data from NatureServe, the National Atlas, the USGS water resources and Nonindigenous Aquatic Species programs, FishNet2, iNaturalist.org, GBIF, and iDigBio.

FishMap.org is sponsored by NANFA. Users can submit their own data to the portal to help map species distribution, so FishMap.org has been working with NANFA members to create an additional database of fish sightings and collections (currently nearly 30,000 records and growing).

Range and Collection Data



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