

Lamprey (Family Petromyzontidae) Diversity in North Carolina

In North Carolina, lampreys constitute a small family of very evolutionary primitive fishes. Most people, including fishermen, are not aware of their existence, unless one is fortunate enough to observe a spawning aggregation in the riffles of a clear Mountain or Coastal Plain stream during the late Winter or early Spring or if one has hooked a large gamefish and wondered what sort of critter was attached to it looking like something out of a science fiction movie. Lampreys are eel-like in appearance being slender, slippery, and without scales or jaws. In fact, many people think that's what they are – some sort of eel. However, lampreys, along with hagfishes, are the most primitive of all fishes, having been around for more than 300 million years. Lampreys range in size from about 100 mm for the smaller Least Brook Lamprey up to 1200 mm (almost 48 inches) and as big around as your fore-arm for fully-grown, adult, Sea Lamprey.

In North Carolina, there are only five species (Table 1) which are widely distributed in many Mountain and Coastal Plain basins, but absent from the Piedmont (Tracy et al. 2020). Lampreys are not known to occur in the Savannah, Pigeon, Watauga, or New basins; all other basins are known to have at least one species (Tracy et al. 2020).

Table 1. Species of lampreys found in North Carolina.

Scientific Name, American Fisheries Society Accepted Common Name	Scientific Name, American Fisheries Society Accepted Common Name
<i>Ichthyomyzon bdellium</i> – Ohio Lamprey	<i>Lethenteron appendix</i> – American Brook Lamprey
<i>Ichthyomyzon greeleyi</i> – Mountain Brook Lamprey	<i>Petromyzon marinus</i> – Sea Lamprey
<i>Lampetra aepyptera</i> – Least Brook Lamprey	

Unlike most fish species found in North Carolina's waters, the Family Petromyzontidae are known simply as lampreys. Their three common names – Ohio, Mountain Brook, Least Brook, American Brook, and Sea lampreys are the American Fisheries Society-accepted common names (Page et al. 2013) and a scientific (Latin) name (Table 1; Appendix 1).

Sea Lamprey is our most widely distributed species being found in eight basins, but historically was probably found in the Broad and Catawba basins and probably occurs in the White Oak, Waccamaw, and the Lumber but just hasn't been detected there yet. Cope (1870a) reported Sea Lamprey from the Catawba basin, possibly as far upstream as at Morganton (Burke County), but there are no verifiable specimens to substantiate his claim (Tracy et al. 2020). In contrast to the Sea Lamprey, American Brook Lamprey is found in only one basin, the French Broad, and even there it is extremely rare, being found only in the lower reaches of Spring Creek in the Town of Hot Springs in Madison County. As compared to other families of fish, e.g., sunfishes, catfishes, and minnows, it is our understanding that no species of lampreys have been introduced outside of their native ranges in North Carolina. That is good news – let's keep it that way!

In the right habitat in many Mountain streams, Mountain Brook Lamprey can be fairly common or abundant. However, other species are generally uncommon or rare. The immature stage of lampreys is called an ammocoete and only vaguely resembles an adult. Ammocoetes, resembling more like an earthworm than a fish, can be found in shallow, sandy, silty areas along the margins of streams. Transforming juveniles and spawning adults are found in riffles, clinging to and moving small stones and pebbles as they construct a spawning nest. Our two parasitic species, when not spawning, are attached to the sides of much larger fish.

Speaking of parasitism, juvenile and adult Sea Lamprey have been found attached to and feeding upon American Shad, Hickory Shad, catfishes, and black bass (*Micropterus* spp.), and other large bodied fish species. Ohio Lamprey have been observed attached to (or evidence of being previously attached to) redhorse suckers, Northern Hog Sucker, Common Carp, black bass, catfishes, and darters (Jenkins and Burkhead 1994) and River Chub. All other species, American Brook Lamprey, Least Brook Lamprey, and Mountain Brook Lamprey, are nonparasitic and non-feeding as adults. Ammocoetes of all species are filter feeders on bacteria, algae, protozoans, and fine particulate organic matter.

Sea Lamprey is an anadromous species meaning that it spawns in fresh water, migrates downstream as juveniles to live and mature in our estuarine coastal waters or the Atlantic Ocean, and then migrates back upstream, often over long distances, as sexually mature adults to spawn in small streams (Rohde et al. 1994). All of our other species are strictly freshwater inhabitants. Sea Lamprey occupy rivers and streams from the Fall Zone throughout the Coastal Plain. Ohio Lamprey inhabits medium sized to large rivers in the Mountains such as the Tuckasegee, French Broad, and Nolichucky rivers. Sometimes co-occurring with Ohio Lamprey, but more often than not, Mountain Brook Lamprey inhabit much smaller Mountain streams than the Ohio Lamprey. Least Brook Lamprey reside in sandy bottom, slow moving, slightly acidic Coastal Plain streams or small streams along the Fall Zone between the Piedmont and the Coastal Plain in the Neuse and Tar basins. As stated previously, American Brook Lamprey is only known from Spring Creek in Madison County.

Because many lamprey species are endemic to specific basins, three species are considered imperiled in North Carolina: Least Brook Lamprey, State Threatened; and Ohio Lamprey and American Brook Lamprey, Special Concern (NCAC 2017; NCWRC 2017; NCNHP 2020).

Key characteristics, which are only visible when examined under a dissecting microscope, for the proper identification of the species include the development and presence or absence of teeth on the oral disc and counting the number of trunk myomeres. Knowing the geographical distributions of the species can also be useful in their identification. However, species, except for big adult Sea Lamprey and Ohio Lamprey, can be difficult to tell apart, especially the ammocoetes. Complicating matters is that several species have ranges that overlap. For example, the range of Sea Lamprey overlaps in part with that of the Least Brook Lamprey and the range of Mountain Brook Lamprey overlaps in part with that of Ohio Lamprey, and American Brook Lamprey (Tracy et al. 2020).

Identification Key to the Species of Lampreys (Family Petromyzontidae) in North Carolina

Oral area surrounded on top and sides by an oral hood that lacks a marginal papillary fringe. Mouth cavity having numerous fimbriate oral cirri (appearing sieve-like). Teeth and tongue absent
**Ammocoetes (Larvae)**

Oral area lacking a hood, being round or oval, disklike (disk puckered partly closed in some specimens), the disk having a papillary fringe. Oral cirri absent. Teeth and tongue present**Adults**

ADULT LAMPREYS

1a. A single indented dorsal fin (Figure 1)2

1b. Two dorsal fins, either widely separate (in ammocoetes) or contiguous in adults (Figure 1).....3

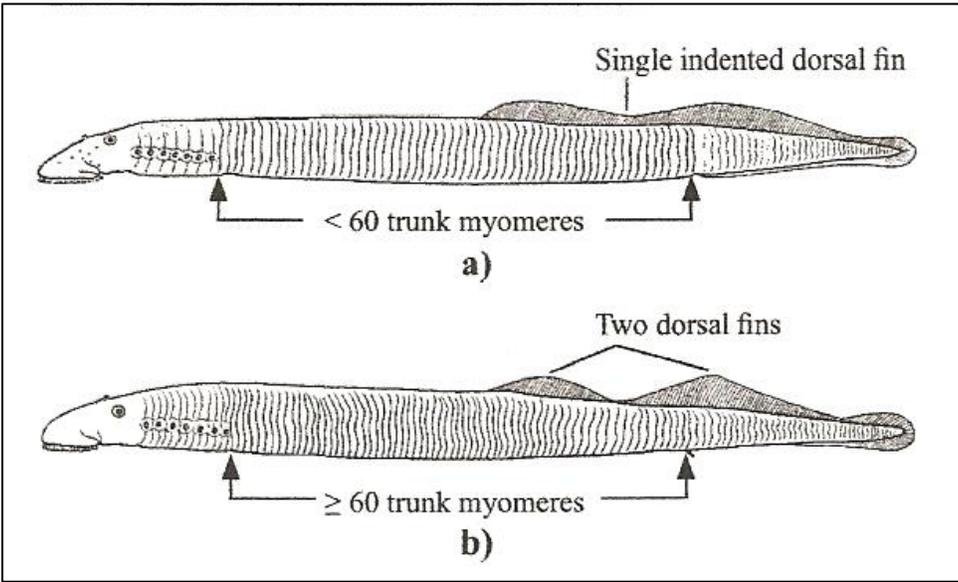


Figure 1. Side view of an adult lamprey showing the trunk myomeres in a) a species with one dorsal fin and b) a species with two dorsal fins. The same method of counting trunk myomeres applies to ammocoetes – counting from the last gill opening to the anus. Illustration courtesy of Renaud (2011)

2a. Lateral line neuromasts on the ventral surface of the branchial region unpigmented. Mature adults non-parasitic with a non-functional intestine that is thin, granular, and fragmentary (only discernible upon dissection). Posterior field teeth bluntly rounded (Figures 2-5)
Mountain Brook Lamprey, [Ichthyomyzon greeleyi](#)

2b. Lateral line neuromasts on the ventral surface of the branchial region darkly pigmented. Mature adults parasitic with a large, smooth, and round functional intestine (only discernible upon dissection). All teeth sharp, strongly pointed (Figures 2-5) Ohio Lamprey, [Ichthyomyzon bdellium](#)

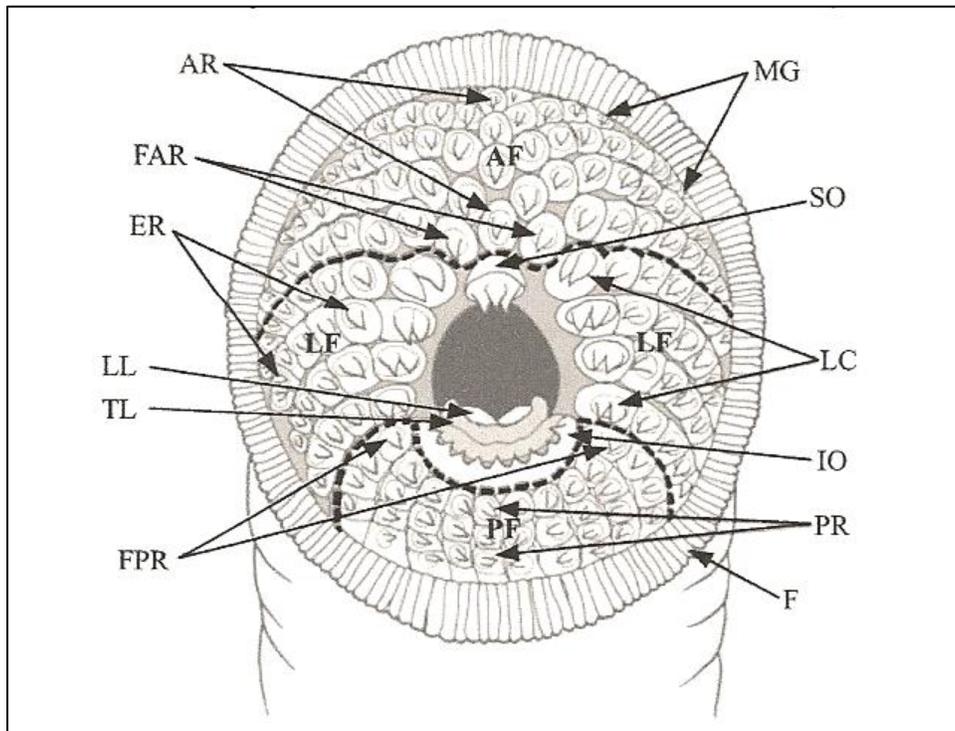


Figure 2. Oral disc of an adult lamprey showing the dentition and other associated structures. The dotted lines delineate the various fields. After Hubbs and Potter (1971). (AF = anterior field; AR = anterior rows; ER = exolateral rows; F = oral fimbria; FAR = first anterior row; FPR = first posterior row; IO = infraoral lamina; LC = lateral circumorals or endolaterals; LF = lateral field; LL = longitudinal lingual lamina; MG = marginals; PF = posterior field; PR = posterior rows; SO = supraoral lamina; TL = transverse lingual lamina). Illustration courtesy of Renaud (2011).

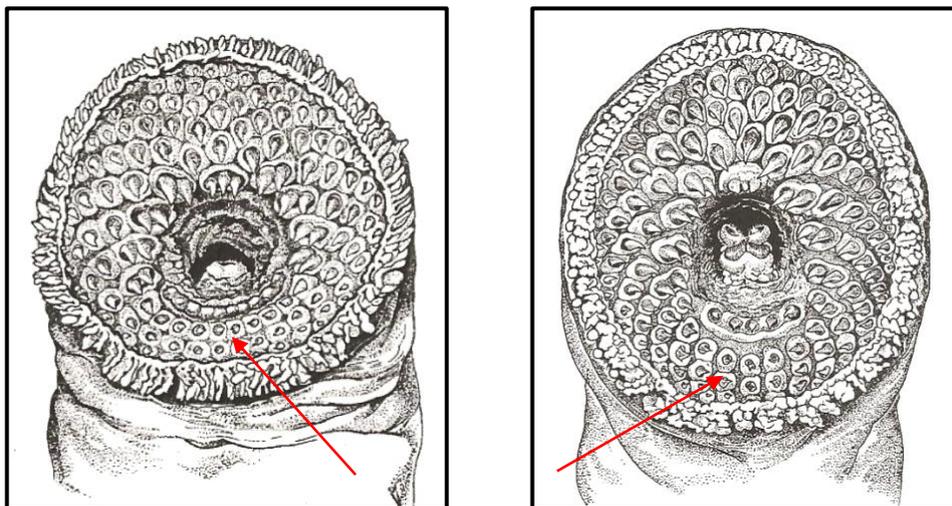


Figure 3. Oral discs of Mountain Brook Lamprey (Left) and Ohio Lamprey (Right) with red arrows pointing to the posterior fields of teeth. Illustrations courtesy of Renaud (2011).

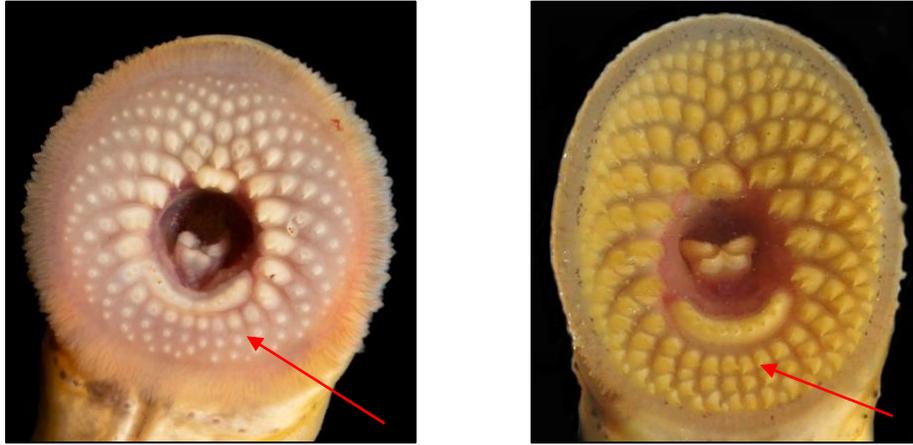


Figure 4. Oral discs of Mountain Brook Lamprey (Left) and Ohio Lamprey (Right) with red arrows pointing to the posterior fields of teeth.



Figure 5. Top – Ohio Lamprey; Bottom - Mountain Brook Lamprey

- 3a. Supraoral lamina a single pointed bicuspid tooth; teeth well-developed (Figures 2 and 6). Parasitic (Figure 7) Sea Lamprey, [Petromyzon marinus](#)
- 3b. Supraoral lamina with two teeth, either unicuspid or bicuspid, separated by a wide bridge, which may or may not bear cusps; teeth not well-developed (Figure 2). Non-parasitic4

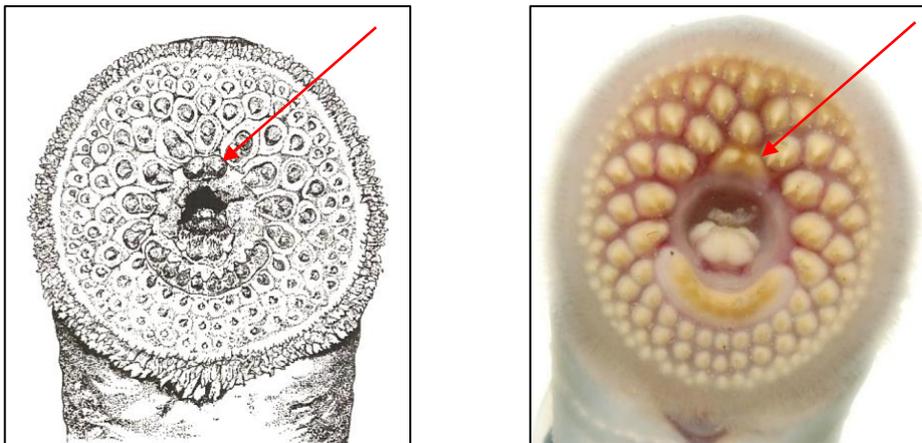


Figure 6. Oral disc of Sea Lamprey with red arrows pointing to the supraoral lamina with a single pointed bicuspid tooth. Illustration courtesy of Renaud (2011).



Figure 7. Young adult Sea Lamprey

- 4a. Trunk myomeres 53-63 (Figure 1). Supraoral tooth cusps widely separated; lateral teeth weakly developed (Figures 8 and 9). Range restricted to the Neuse and Tar basins (Figure 10) Least Brook Lamprey, [Lampetra aepyptera](#)
- 4b. Trunk myomeres, 59-74 (Figure 1). Supraoral tooth cusps not as widely separated; lateral teeth moderately developed (Figures 8 and 9. Range restricted to the Spring Creek watershed in Madison County, French Broad basin (Figure 11) American Brook Lamprey, [Lethenteron appendix](#)

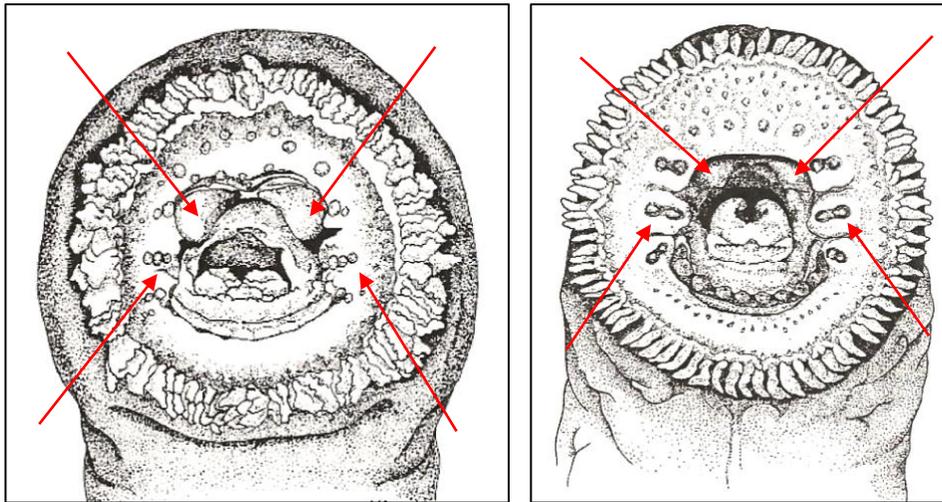


Figure 8. Left - Oral disc of Least Brook Lamprey with red arrows pointing to well separated supraoral tooth cusps and weakly developed lateral teeth; Right – Oral disc of American Brook Lamprey with red arrows pointing to not as widely separated supraoral tooth cusps and moderately developed lateral teeth. Illustrations courtesy of Renaud (2011).



Figure 9. Left - Oral disc of Least Brook Lamprey with white arrows pointing to well separated supraoral tooth cusps and weakly developed lateral teeth; Right – Oral disc of American Brook Lamprey with white arrows pointing to not as widely separated supraoral tooth cusps and moderately developed lateral teeth.



Figure 10. Least Brook Lamprey. Top – Male; Bottom – Female.



Figure 11. American Brook Lamprey; not completely transformed from ammocoete to adult. Photograph courtesy of David Neely.

AMMOCOETE (LARVAL) LAMPREYS

- 1a. Single slightly indented dorsal fin (Figures 1 and 12)2
- 1b. Two dorsal fins (a low lying membrane not supported by fin rays may unite the two fins especially in smaller specimens) (Figure 1).....3



Figure 12. Ammocoete of Mountain Brook Lamprey

- 2a. Subocular area unpigmented to lightly pigmented...Mountain Brook Lamprey, [*Ichthyomyzon greeleyi*](#)*
- 2b. Subocular area moderately pigmentedOhio Lamprey, [*Ichthyomyzon bdellium*](#)*

*[Where their distributions are sympatric, adult Ohio Lamprey, *Ichthyomyzon bdellium*, may be easily separated from adult Mountain Brook Lamprey, *Ichthyomyzon greeleyi*. However, the ammocoetes (larvae) cannot be easily separated, contrary to Lanteigne (1988) and Renaud (2011) (Jenkins and Burkhead 1994; B.H. Tracy, pers. obs.) (Tracy et al. 2020).]

- 3a. Trunk myomeres 51-60 (Figure 1)Least Brook Lamprey, [*Lampetra aepyptera*](#)
- 3b. Trunk myomeres 61-74 (Figure 1)4
- 4a. Range restricted to the Spring Creek watershed in Madison County, French Broad basin
.....American Brook Lamprey, [*Lethenteron appendix*](#)
- 4b. Range restricted to Atlantic slope basins (i.e., Yadkin, Shallotte, Cape Fear, Neuse, Tar, Roanoke, Chowan, Albemarle Sound) Sea Lamprey, [*Petromyzon marinus*](#)