

Family Petromyzontidae

Lampreys

Lampreys are not fishes. They are a distinct lineage of vertebrates traditionally associated with fishes. Lampreys evolved in the marine environment and originated in the Ordovician period, at least 450 million years ago. This makes them survivors of five of the Earth's great extinction events. Lampreys are often thought to be related to hagfish (Myxiniiformes), which are a sister group to lampreys. Ammocoetes, the filter-feeding worm-like larval stage of modern lampreys, have long influenced hypotheses of vertebrate ancestry. The life history of modern lampreys, from a superficially amphioxus-like ammocoete to a specialised predatory adult, was thought to exemplify the origin of vertebrates. However, recent analyses of immature specimens of Palaeozoic stem lampreys show that they lack an ammocoete larval stage. Ammocoetes are specialisations of the life history of modern lampreys rather than relics of vertebrate ancestry. Since modern hagfish also lack a larval stage, the last common ancestor of hagfish and lampreys was probably a macrophagous predator without a filter-feeding larval stage. The earliest known record of the ontogenic transition from ammocoete to adult is *Mesomyzon* from Early Cretaceous lake beds in China. All modern lamprey lineages have evolved in freshwater within the last 200 million years. The derived state of an ammocoete and the prolonged filter-feeding larval phase undoubtedly delayed the need for the endocrine function of a thyroid gland in iodine-poor freshwater environments. This is one of the mechanisms that allowed lampreys to evolve in freshwater.

Lampreys are jawless and eel-like animals with seven roundish gill openings behind the eye but lacking paired fins. They have a very distinctive oral disc armed with rows of horny teeth, which they use to attach themselves to surfaces and prey. The dentition of the oral disc is an important character in identifying genera (Figure 26–27). All lampreys are found in cooler waters above 20° northern and southern latitudes. Petromyzontidae are found in the north, while a few species of other families are found in the southern hemisphere.

Lampreys spawn in spring and die shortly after spawning. They spend several years in a larval stage (ammocoete). The duration of the ammocoete stage is still controversial, but we know that lamprey species in West Asia undergo metamorphosis between late summer and early winter. Juveniles are always shorter than adult ammocoetes (larvae shrink during metamorphosis). Migrating *Petromyzon marinus* are attracted by steroidal pheromones released by stream-dwelling larvae, which indicate habitat suitability. These compounds are detected at extremely low concentrations and are released in large quantities. Laboratory experiments show that each *Petromyzon* larva activates at least 400 l of water per hour. Spawning lampreys cease their normal daylight avoidance and spawn on sunny days. The male arrives first at the spawning site and releases a bile acid that acts as a sex pheromone, inducing the ovulated female to search for him. Spawning generally occurs in fast-flowing water, often at the head of riffles in streams. During spawning, the male attaches to the female's neck and wraps his body around her. The female then deposits the eggs in the gravel with her belly.

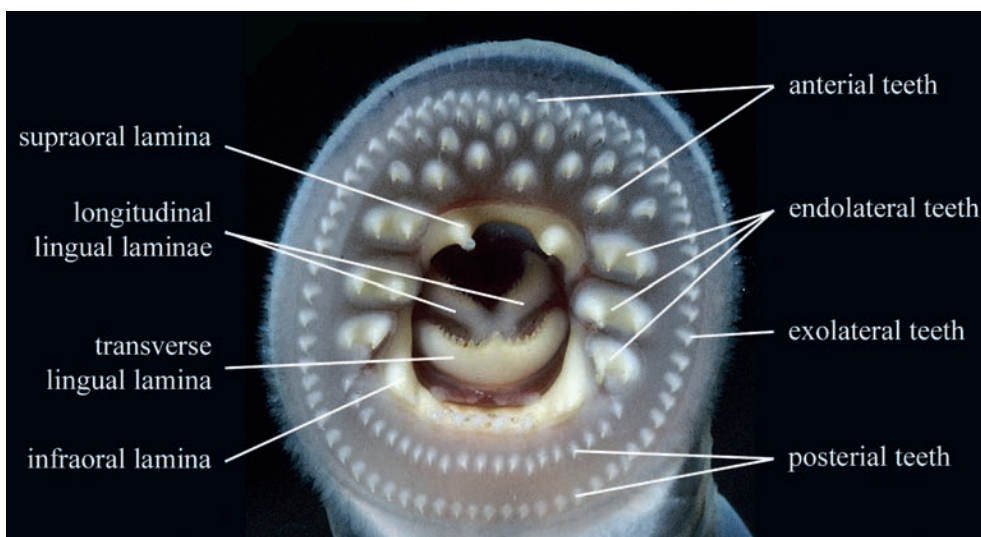


Figure 26. Oral disc of *Lethenteron camtschaticum* and dentition terminology (from Kottelat & Freyhof 2007, © N. Akiyama).

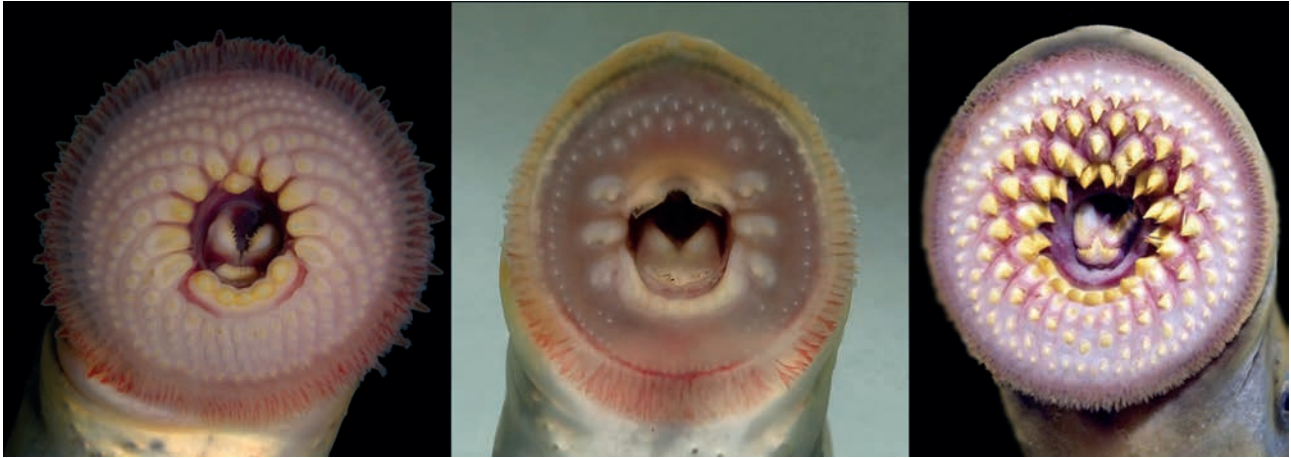


Figure 27. Mouth of Petromyzontidae: from left: *Caspiomyzon wagneri*; *Lampetra ninae*; *Petromyzon marinus* (© A. Hartl).

Of the four species from West Asia, two are anadromous: *Caspiomyzon wagneri* and *Petromyzon marinus*. *Caspiomyzon* is a predatory species, and *Petromyzon* is parasitic. The two species of *Lampetra* in West Asia are sedentary; they do not feed after metamorphosis. Instead, they spawn in the spring after metamorphosis. Other species of *Lampetra* are found in Europe.

Further reading. Vladykov & Kott 1979 (diversity, distribution); Hardisty & Potter 1971–1982, Hardisty 1979, Hardisty 1986a (biology); Youson & Sower 2001 (thyroid hormones); Gills et al. 2003 (phylogeny); Sorensen et al. 2005 (pheromone); Gess et al. 2006 (fossils); Lang et al. 2009 (phylogeny); Docker et al. 2015 (review); Miyashita et al. 2021 (evolution of ammocoetes); Hughes et. al. 2025 (generic concept).

Key to lampreys in West Asia

1a - Supraoral lamina narrow, with a single tooth or two adjacent teeth; anterial, posterial, and exolateral teeth numerous, in regular backward-curved radiating rows.

.....2

1b - Supraoral lamina transversely elongate, with a single tooth at each end; if present, anterial, posterial, and exolateral teeth not in regular backward-curved radiating rows.

.....3

2a - Infraoral lamina with 4–6 large, blunt teeth; oral disc width less than body width.

.....*Caspiomyzon wagneri*

2b - Infraoral lamina with 7–8 large, sharp teeth; oral disc width greater than body width.

.....*Petromyzon marinus*

3a - Posterial teeth absent or only two single unicuspid teeth.

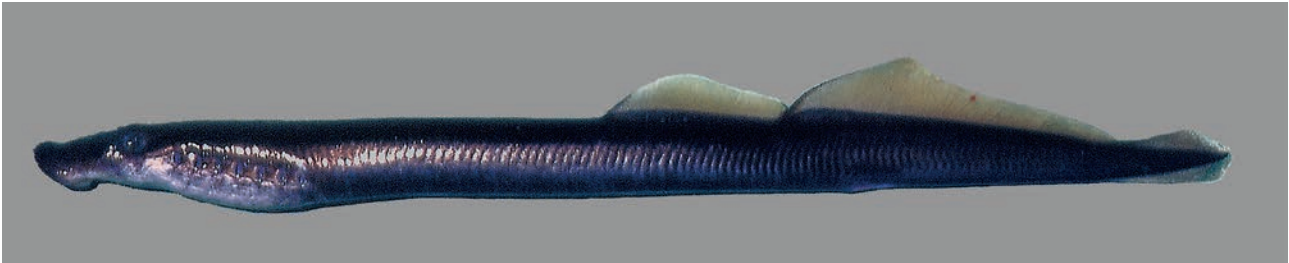
.....*Lampetra lanceolata*

3b - Posterial teeth usually present in an interrupted or complete row, 4–23 unicuspid and bicuspid teeth.

.....*Lampetra ninae*



Caspiomyzon wagneri; Tajan, Iran; ~400 mm TL.



Caspiomyzon wagneri; Samur, Russia; 247 mm TL. © A. Naseka.

Caspiomyzon

The genus *Caspiomyzon* comprises three species: one migratory and feeding as adults, and the other two are resident brook lampreys, not feeding as adults. While *C. wagneri* is widespread, especially in the southern Caspian basin, both *Caspiomyzon* brook lampreys (*C. hellenicus*, *C. graecus*) are locally endemic to the Mediterranean basin (Greece and Albania). Both have been described in the European genus *Eudontomyzon*, and their placement in *Caspiomyzon* raises some interesting biogeographic questions, as *Caspiomyzon* does not occur in the Black Sea basin. A migratory lamprey historically known from the Black Sea basin was initially placed in the genus *Eudontomyzon*, but when rediscovered, it was identified as a species of *Lampetra*.

Caspiomyzon wagneri

Common name. Caspian lamprey.

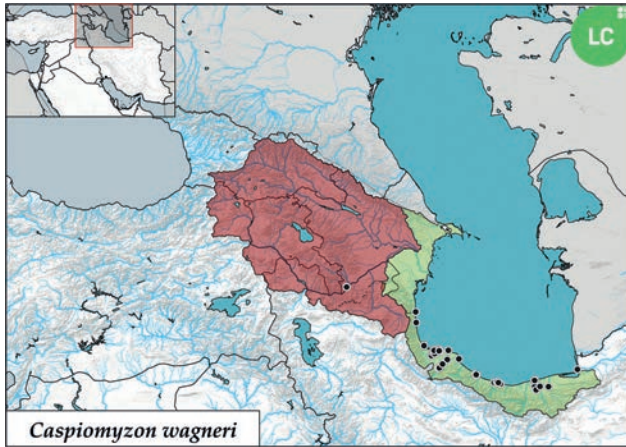
Diagnosis. Distinguished from other species of lampreys in West Asia by: ● many small teeth in regular backwards-curved radiating rows / ○ all teeth low, blunt, button-shaped / ○ supraoral lamina short, with one, rarely

two closely connected teeth / ● supraoral lamina tooth blunt / ● infraoral lamina with 4–6 large teeth / ○ oral disc width less than body width / ○ ammocoetes with 53–68 trunk myomeres. Size up to 575 mm TL.

Distribution. Caspian Sea and most (even relatively small) tributaries. In West Asia, Kura drainage, up to Astara, lower Aras (Azerbaijan), and coastal Caspian rivers east to Gorgan. In Iran, now restricted to a few rivers, between Sefid to Gorgan. Also found in European Caspian basin. Migrated to uppermost tributaries of Volga (1500 km), but spawn along all rivers where suitable substrate exists.

Habitat. Adults live in sea caught down to depths of 600–700 m. Spawns in sections of rivers and streams with strong currents. Ammocoetes live in detritus-rich sand or clay sediments, selecting and changing habitats according to sediment size as they grow.

Biology. Anadromous; upstream migration of adults in autumn and spring. In Kura and Iran, autumn run begins in late October and peaks in December and January; spring run begins in mid-March to late May, with peak spawning migration in April (at 16°C) (Iran). In shorter rivers, most individuals migrate in spring. Migration occurs at dusk



and night, peaking about 2 hours after sunset and during daylight hours when water temperature rises to 13–14°C. Migrate 2–16 km per night. Spawn in pairs in March–June (rarely in July) when temperature reaches 13–23°C. Eggs laid in crescent-shaped nests made of gravel and small stones. Ammocoetes hatch in 8–10 days. Ammocoete stage lasts 2–4 years. Feeds on detritus and microorganisms. Metamorphosis begins in mid-July and lasts until October. After metamorphosis, juveniles migrate to sea until December of same year. Adults stay at sea for at least 17 months. In lower Volga, occurrence of small (about 190–310 mm TL) and large (370–550 mm TL) mature adults suggests that adults may feed one or two summers before spawning. Feeding behaviour unknown. Due to their fat content and abundance, dried *C. wagneri* were formerly used as candles in Russia.

Conservation status. LC; historically found in all Caspian rivers. Limited by dams to lower part of rivers. Discharged when caught in Iran due to religious reasons. Rare, with only a few remaining spawning sites in rivers draining from eastern Caucasus, where it might have stabilised at a low level. In Volga, a sharp decline was observed during the 20th century. Potentially still abundant in Ural, but more information is needed at present. The status of

landlocked populations in reservoirs in lower Volga must be confirmed.

Further reading. Berg 1949b, Holčík 1986 (biology); Renaud 2011 (morphology, biology); Coad 2016c (review); Abdoli et al. 2017 (migration pattern); Nazari et al. 2017 (biology).

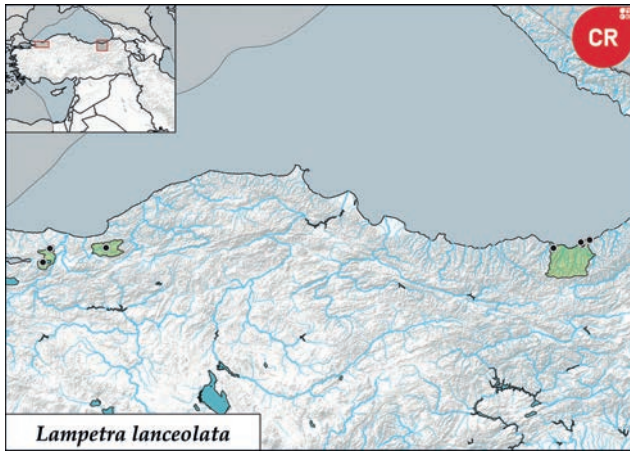
Lampetra

There are 13 species in the genus, 4 of which are predatory and 9 nonpredatory brook lampreys. Most are known from Europe and the Asian part of the Black Sea basin. Several North American species are still placed in *Lampetra*, as a global phylogeny of lampreys shows that the genus *Lampetra* is not restricted to the Western Palearctic. The evolution of brook lampreys has been much discussed in *Lampetra*. Brook lampreys are superficially similar to migratory lampreys of the same genus but do not smoltify and migrate downstream after metamorphosis. Instead, they remain in the streams and spawn in the approaching spring without feeding. As brook lampreys do not feed after metamorphosis, they do not grow (but shrink). Both predatory and brook lampreys may spawn simultaneously at the same sites, but they are reproductively isolated due to their size-related mating behaviour. However, it has always been believed that brook lampreys evolve from migratory lampreys, and ecological factors during their larval phase have been discussed to trigger whether or not they become migratory. Several studies have attempted to determine whether their nucleotides support the independent occurrence of predatory and nonpredatory lampreys and their recognition as separate species. The question is whether the two constitute different life-history strategies of a single but phenotypically highly bipolar species.

Analyses of mitochondrial markers from a geographically broad set of Central and Southwest European *Lampetra* populations definitively demonstrated nonmonophyly in the widespread Central European nonpredatory species *L. planeri* compared to the predatory *L. fluviatilis*. However, it remains to be seen if this is due to ongoing gene flow or incomplete lineage sorting.



Lampetra planeri; Danube drainage, Germany; newly hatched ammocoete, ~10 mm TL. © A. Hartl.



Lampetra lanceolata; İyidere, Türkiye; 129 mm TL.

A comprehensive genome-wide comparison of a predatory/nonpredatory species pair from the same location (*L. fluviatilis*/*L. planeri*) revealed strong genetic differentiation despite shared mitochondrial haplotypes in these two populations. This genome-wide strong differentiation is likely the rule, not an exception. After decades of research, we still need to learn how brook lampreys evolved from predatory lampreys. This is an area that will undoubtedly attract further research in the future.

All non-feeding species of *Lampetra* have likely evolved from *L. fluviatilis* and its ancestors. Furthermore, all brook lampreys have been isolated from this predatory lamprey at different times. Finally, an additional migratory species was widespread in the northern Black Sea basin, where *L. fluviatilis* is not found. This species was previously referred to as *Eudontomyzon* sp. “Migratory” until, after more than 100 years without records, such an animal was found in the Sea of Azov. This individual was identified as a migratory species of *Lampetra*. Due to the political unrest in Eastern Ukraine, no new data could be collected on this very rare lamprey, and thus, no molecular data are available for this species. This migratory *Lampetra* species from the Sea of Azov is likely related to *L. lanceolata* and *L. ninae*. **Further reading.** Naseka & Diripasko 2008 (rediscovery of Black Sea lamprey); Lang et al. 2009 (phylogeny); Mateus et al. 2013, Espanhol et al. 2007, Pereira et al. 2010 (book lampreys).

Lampetra lanceolata

Common name. Anatolian brook lamprey.

Diagnosis. Distinguished from *L. ninae* by: ● posterial teeth absent or only two unicuspid teeth present. Size up to 140 mm TL in adults, 173 mm TL in ammocoetes.

Distribution. Türkiye: İyidere and Yanbolu drainages, coastal streams flowing into Black Sea between Rize and Trabzon, also in upper Melen, and streams flowing into Lake Sapanca.

Habitat. Lower parts of rivers with slow currents and bottoms rich in organic material. Ammocoetes live in detritus-rich sand or clay sediments. Spawns on gravel substrate.

Biology. Nonpredatory, freshwater resident. Larvae begin metamorphosis after third summer and reach a total length of 130 mm at end of summer. Likely to spawn in April and May at water temperatures between 13 and 15°C.

Conservation status. CR; distributed up to 15 km inland from mouth of İyidere, where it has declined sharply and is now very rare. There are now six hydroelectric dams in the İyidere, which caused massive habitat change due to pulsed flooding. Status and distribution in other streams are unknown. Very rare in Sapanca Lake basin.

Further reading. Kux & Steiner 1972 (description); Lang et al. 2009 (generic position); Gözler et al. 2011 (ecology); Renaud 2011 (description).



Lampetra ninae; Shakhe, Russia; 164 mm TL. © S. Tuniev.

Lampetra ninae

Common name. Caucasian brook lamprey.

Diagnosis. Distinguished from *L. lanceolata* by: ● posterial teeth usually present in interrupted or complete rows, 4–23 unicuspid and bicuspid teeth. Size up to 166 mm TL in adults, slightly longer in ammocoetes.

Distribution. Caucasian Black Sea basin of Russia and Georgia: Shakhe, Mzymta, and Chakhtsutsyr drainages south to Bzyb' and Mokva in Abkhazia (Georgia) south to the border between Georgia and Türkiye.

Habitat. Foothills zones in clear, well-oxygenated brooks. Ammocoetes live in detritus-rich sands or clay sediments.

Biology. Nonpredatory, freshwater resident. Metamorphose in autumn. Spawning biology unknown but suspected to be identical to *L. lanceolata*, which overwinters and spawns in spring.

Conservation status. LC; still common and widespread within its small range.

Remarks. Described as a species of the Arctic genus *Lethenteron*. Molecular studies indicate that it is very closely



Petromyzon marinus; Rhine drainage; Germany; ammocoete, ~100 mm TL.



Petromyzon marinus; Rhine drainage; Germany; juvenile, ~120 mm TL.



Petromyzon marinus; Rhine drainage; Germany; adult, ~850 mm TL. © A Hartl.

related to *L. lanceolata*. Both may be conspecific, and further research is needed.

Further reading. Lang et al. 2009 (generic position); Naseka et al. 2009 (description); Naseka et al. 2016 (description, distribution).

Petromyzon

The monotypic genus occurs in North America, North Africa, Europe, and occasionally in the Eastern Mediterranean. It is one of the largest lampreys in the world and the most well-known and best studied, especially due to its invasion and tremendous effects in the North American Great Lakes. There is no record of larvae or an established population of *Petromyzon* in West Asia. Therefore, the solitary individuals found are likely stayers from the western Mediterranean population. On the other hand, larvae are difficult to find, and more research is needed.

Petromyzon marinus

Common name. Sea lamprey.

Diagnosis. Distinguished from other species of family in West Asia by: ● adults grey to yellow with dark-brown blotches, no blotches in juveniles / ○ supraoral lamina short, with two adjacent teeth / ● infraoral lamina with 7–8 large, sharp teeth / ○ oral disc wider than body width / ○ many small teeth on oral disc, in regular backward-curved radiating rows / ○ all teeth sharp / ● 66–75 trunk myomeres / ○ ammocoetes with black pigment on caudal. Size up to 1200 mm TL.

Distribution. Occurs very irregularly in Mediterranean rivers in Türkiye. Widespread on both sides of North Atlantic, north to Iceland, and along Norwegian coast to Barents Sea (Ura, Kola Peninsula). North Sea, Baltic, and western and central Mediterranean basins very rare in eastern Mediterranean and Baltic basins. Several land-locked populations in North America.

Habitat. Adults at sea offshore. Spawns in strong-current habitats of rivers and streams. Ammocoetes in detritus-rich sand or clay sediments.

Biology. Anadromous, parasitic. Adults migrate to rivers in autumn and winter. Spawns in pairs, April–July, mostly in May and early June, when temperatures reach at least 15°C. Spawning individuals stop their normal daylight avoidance response and breed on sunny days. Male dig a shallow nest in areas with strong currents. Ammocoete stage lasts 5½–7½ years. Feeds on diatoms and detritus, metamorphoses at 130–150 mm TL in late summer, and migrates to sea. Adults parasitise various fish species at sea, even whales and other cetaceans. It usually does not kill its hosts but feeds on small amounts of blood and body fluid from a single host for several days. Adults feed for about 3 years before migrating to spawning grounds.

Conservation status. LC; rare but widespread. Populations in Europe, which had declined due to pollution, have recovered since the 1980s but appear to be declining again in recent years.

Remarks. In 1921, 90 years after opening of the Welland Canal, the Lake Ontario population entered other Great Lakes of North America. Combined with other factors, this caused a sharp decline in many native species and the extinction of three endemic coregonids.

Further reading. Potter & Osborne 1975 (identification); Hardisty 1986b (biology); Rodríguez-Muñoz et al. 2004 (genetics); Çevik et al. 2010 (record in Türkiye).

