

Family Clariidae

Air-breathing catfishes

The family of air-breathing catfishes comprises approximately 120 species in 16 genera. Phylogenetic diversity is greatest in South and Southeast Asia, where most genera are found. The genus *Clarias* is the largest genus in the family and is distributed across Asia and Africa. Most species in the genus *Clarias* are found in Africa, where they have invaded from Asia only once and diversified there. Airsac catfishes of the former family Heteropneustidae are included in the family Clariidae. Air-breathing catfishes can thrive in various ecosystems, including marshes and rivers, as well as rainforest streams, desert pools, lakes, subterranean waters, and many artificial waterbodies. They can reach high densities, and due to their often large size, they are of major ecological and commercial importance in tropical Asia and Africa.

As their common name suggests, Clariids breathe air through a specialised organ. An opening between the second and third gill arches leads to a suprabranchial chamber with highly vascularised, brush-like structures called “trees.” These dendritic organs are situated above and behind the gills and are supported by epibranchials of the second and fourth branchial arches. The first of these is smaller and lies in the anterior compartment. Each is a highly branched tree-like structure supported by a cartilaginous internal skeleton. This feature enables them to survive for extended periods out of water. *Heteropneustes* have a lung-like outgrowth from the pharynx. Some *Clarias* species can “walk” a few meters on land to seek alternative habitats, using sturdy spines on their pectorals. *Clarias* catfishes are weakly electric, and their electricity is used



Figure 53. Suprabranchial chamber with ‘tree’ in *Clarias gariepinus*.

for communication and to find food. It is challenging for a human observer to perceive their electricity directly, as it is too weak to be sensed.

Clarias gariepinus and *Clarias* sp. are among the most significant globally invasive species. Both are major aquaculture species within their native range, and both, as well as several hybrids, including other Clariids, are increasingly farmed outside their range for their boneless flesh. They are most commonly imported for farming or aquaria. Still, because they are easy to translocate, private individuals often introduce them into residential or community ponds, aiming to harvest them for food. In all of these situations, they may escape or be released intentionally.

Further reading. Agnese & Teugels 2005; Sullivan et al. 2006; Pouyaud & Paradis 2009 (diversity, phylogeny); Mbanga et al. 2018 (respiratory organ).

Key to Clariidae in West Asia

1a - Dorsal short, 6–7 rays.

.....*Heteropneustes fossilis*

1b - Dorsal very long, 61–79 rays.

.....2

2a - Stout, body depth strongly increasing to vertical of pelvic origin, then decreasing; anterior margin of pectoral spine rugose and with irregular bumps; posterior dorsal tip reaching to or beyond caudal base; flank brown or grey often with vertical series of yellowish spots.

.....*Clarias* sp.

2b - Slender, eel-like, body depth slightly increasing to dorsal origin, then decreasing; anterior margin of pectoral spine serrated; posterior dorsal tip not reaching to caudal base; flank brown or grey with dark-brown mottling.

.....*Clarias gariepinus*

Clarias gariepinus

Common name. Sharptooth catfish.

Diagnosis. Distinguished from *Clarias* sp. in West Asia by: ● body slender, eel-like / ● body depth slightly increasing to dorsal origin, then decreasing / ● anterior margin of pectoral spine serrated / ● posterior dorsal tip not reaching to caudal base / ● flank brown or grey with dark-brown mottling. Size up to 1500 mm SL and 60 kg, usually about 700 mm SL.

Distribution. Native to Jordan drainage and coastal streams of Israel. Introduced in Azraq oasis, Orontes drainage in Syria and Türkiye. Widespread in southern Türkiye from Orontes to Göksu, probably elsewhere along Mediterranean coast. Also, in warm springs in Sakarya, Lake Burdur basin (Türkiye), Al-Kharj south of Riyadh, and Medina (Saudi Arabia). Probably found elsewhere. Nearly pan-African range, absent only from North Africa except Algeria, where it occurs in streams in Tolga oasis on northern edge of Sahara and gueltas on north slopes of Tassili n' Ajjer. Tibesti and Ennedi massifs of Chad. Widespread in Nile and Niger drainages, eastern and southern Africa, but absent from upper and lower Guinea, Cape prov. and probably Nogal prov. of South Africa. Introduced in other parts of Africa, tropical and subtropical Asia, and South America. Occasional escapes from warm water aquaculture facilities in Europe are not established in natural waters but only in artificially heated waters.

Habitat. Slow-flowing or standing waters of lakes, marshes, reservoirs, and lowland rivers, rarely in fast-flowing waters. Often found in canals with both sewage and treated water. Tolerant of extreme environmental conditions, including temperatures as low as 8°C and very low oxygen conditions.

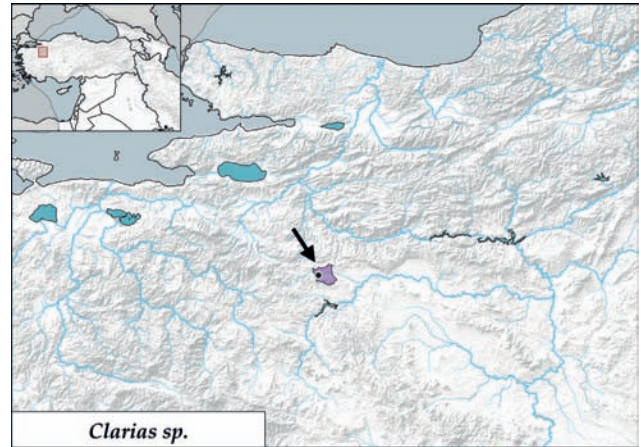
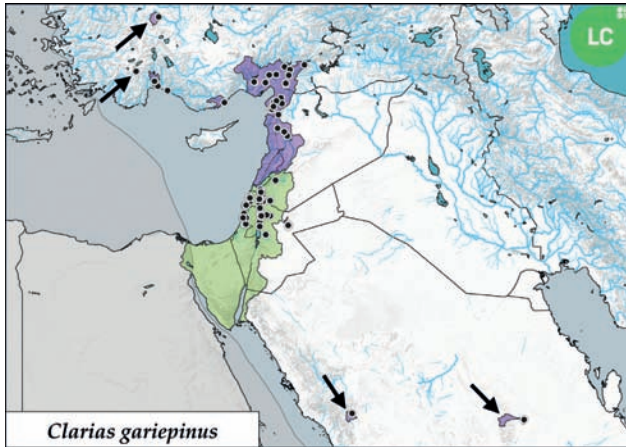
Biology. Lives up to 8 years. Matures at about 300–350 mm SL (males), 350–400 mm SL (females). An accessory respiratory organ allows this species to breathe air. Often found in muddy bottoms of dry ponds, occasionally swallowing air through mouth. Dependent on atmospheric oxygen and will drown if cut off from surface. Can leave water using its strong pectoral spines and move to new areas through very shallow channels. Spawning is usually triggered by rising water levels and flooding shallow areas. Spawns throughout year when water temperatures are above 22°C. Migrates to rivers and temporary streams to spawn. Spawns usually at night in shallow, flooded areas. Courtship often preceded by highly aggressive encounters between males. Generates monophasic, head-positive electrical discharges of 5–260 microSiemens during intra-specific aggressive interactions. Mating position, a form of amplexus, is maintained for several seconds. In amplexus, male lies in a U-shaped curve around female's head. Sperm and eggs are released, followed by a vigorous female tail swish to spread eggs over a wide area. Pairs mate several times during a spawning night. Parents do not guard eggs or larvae. Eggs adhere to vegetation. Larvae usually begin feeding 48–72 hours after hatching (23–28°C). Nocturnal bottom feeders on invertebrates and fish, occasionally taking young birds, rotting flesh, and plants. An important commercial species in Africa. An important aquaculture species in warm-water and tropical countries, introduced almost worldwide.

Conservation status. LC.

Further reading. Teugels 1986 (distribution); Bruton 1979 (biology).



Clarias gariepinus, Lake Burdur basin, Türkiye, ~250 mm SL.



Clarias sp.

Common name. Walking catfish.

Diagnosis. Distinguished from *C. gariepinus* by: ● body stout, its depth strongly increasing to vertical of pelvic origin, then decreasing / ● anterior margin of pectoral spine rugose and with irregular bumps / ● posterior dorsal tip reaching to or beyond caudal base / ● flank brown or grey, often with vertical series of yellowish spots. Size up to 450 mm SL and 1.2 kg, usually about 250 mm SL.

Distribution. Hot springs in upper Sakarya. Native to Philippines and introduced in tropical areas worldwide.

Habitat. Lowland habitats such as marshes, ponds, lakes, rice fields, and rivers, often in relatively small lowland and hill streams. Most commonly found in stagnant, muddy water, but also in clear springs and lakes.

Biology. In native range, matures at about 280 mm SL and spawns during rainy season when rivers rise. An accessory respiratory organ allows this species to breathe air. Dependent on atmospheric oxygen and will drown if cut off from surface. Usually makes lateral migrations into flooded forests and fields during wet season to feed and spawn. Can use its strong pectoral spines to leave water and move to new areas through very shallow channels. Mating position

in a form of amplexus is maintained for several seconds. In amplexus, male lies in a U-shaped curve around female's head. Sperm and eggs are released, followed by a vigorous flick of female's tail to disperse eggs over a wide area. Pairs mate several times during a spawning night. Males excavate nests in submerged mud banks but do not guard eggs or larvae. Eggs adhere to vegetation. Nocturnal bottom feeders on invertebrates and fish, occasionally on plants. An important commercial species in Southeast Asia and for aquaculture in warm-water and tropical countries, introduced almost worldwide.

Conservation status. Non-native; released from aquaria or aquaculture.

Remarks. This species is usually identified as *C. batrachus*, which is known only from Java in Indonesia. Records of *C. batrachus* from mainland Southeast Asia, Sundaic Southeast Asia, and the large pantropical non-native range suggest two other species are involved in what is called *C. batrachus*. Non-native populations need to be better identified, and it cannot be excluded that they represent undescribed species or hybrids between different species.

Further reading. Ng & Kottelat 2008 (identification); Emiroğlu et al. 2020 (upper Sakarya).



Clarias sp., Nha Trang, Vietnam, ~200 mm SL.



Heteropneustes fossilis; Greater Zab; Iraq; 87 mm SL.

Heteropneustes fossilis

Common name. Stinging catfish.

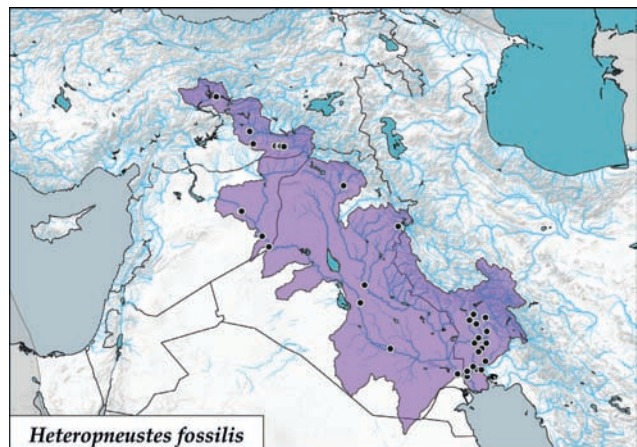
Diagnosis. Distinguished from other species of catfishes in West Asia by: ○ adipose absent / ○ nasal barbel present, very long / ○ anal long, 60–70 rays / ○ dorsal short, 6–7 rays, without spine. Size up to 280 mm SL.

Distribution. Euphrates and Tigris drainages. In Tigris, from about Diyarbakır and Syrian Euphrates south to southern marshes and Shatt al Arab/Arvand in Iraq. Common in rivers and marshes of Khuzestan prov. in Iran, in Azadegan, and Karkheh. Native from Indus east to Myanmar.

Habitat. Slow-flowing rivers, marshes, reservoirs, and lakes with fresh or slightly brackish water. Can inhabit heavily polluted habitats and waters with very low oxygen levels, survive in semi-liquid mud, move overland, and move to bottom of cracks and crevices formed by mud cracking.

Biology. Usually gregarious. Spawns first time at 1 year and about 50–100 mm SL (India). Spawns under water surface. Mating position, held in a form of amplexus for several seconds. Several copulations during a spawn. Does not guard eggs or larvae. Two tubular air sacs extending from gill cavity almost to caudal peduncle. Bimodal respirator and may respire aerally by gulping air at different intervals when oxygen content of water is reduced below saturation. Digs burrows in form of anastomosing tubes with multiple exits; up to 364 individuals have been found in one burrow complex. Feeds on a wide variety of invertebrates and plant material.

Conservation status. Non-native; first reported from Iraq and Iran in 1950s. Most likely introduced to control *Bulinus truncatus* snails, an important schistosomiasis vector. Still expanding its range northwards. Locally threatened by overexploitation for human consumption in its native range.



Remarks. Regarded as a pest in West Asia and not eaten. High market value and demand in India, where the species is used for medicinal purposes. Stinging catfish have the pectoral spine connected to a venom gland. Freshly caught or netted fish swing their heads from side to side and are active venomators. The venom is neurotoxic, hemolytic, and very painful. A sting in hand causes severe swelling, usually over the whole arm. The swelling and pain will subside in about a day, and the sting may take up to two weeks to heal. If the venom is squeezed and sucked out of sting, the effect can be negligible. While *Clarias* also have some sacs for breathing atmospheric air, in *Heteropneustes*, this structure is much more developed and resembles lungs. The air chambers begin above the gills and extend back to the tail as long, tubular sacs that emerge from the branchial cavity between the second and third gill arches and lie close to the backbone.

Further reading. Datta et al. 1982; Whitear et al. 1991 (venom); Coad 2010a (introduction, biology); Ünlü et al. 2011 (range expansion).

Fish physiology: Getting rid of waste without water. Most nitrogenous wastes in fish are produced and excreted as ammonia or urea. Animals that excrete their nitrogenous wastes primarily as ammonia (NH_3) are classified as ammoniotelic, including agnathans and most teleost fish. Approximately 80–90 % of their nitrogenous wastes are excreted as ammonia, with the remainder excreted as urea. In high concentrations, ammonia is highly toxic, as it increases the internal pH of the cells, inhibiting key enzymes required for energy generation. Most air-breathing teleosts are primarily ammoniotelic but appear to have retained the genes for the urea cycle enzymes since a full complement of urea cycle enzymes has been reported for many of them. The capacity to synthesise urea in these fish may be an adaptation to their amphibious nature and their normal habitat of marshes, where the water ammonia level may be quite high, often rendering it uninhabitable to typical freshwater fish. *Heteropneustes fossilis* is capable of tolerating extremely high levels of total ammonia in its environment (up to 75 mM ammonium chloride vs. 100–200 μM , rarely up to 1000 μM in most fishes, up to 40–80 μM in humans). It can do so for extended periods without any adverse effects. When exposed to stressful conditions, the transition from ammoniotelism to ureotelism occurs in some air-breathing fishes. This happens when they live in semi-dry conditions inside mud during habitat drying. Although the real mechanism(s) of regulation of ureogenesis is unclear, it is hypothesised that the accumulation of ammonia within the body is likely the internal modulator for enhanced ureogenesis. This is mainly to avoid any build-up of ammonia to a level that can be toxic. It is hypothesised that the urea cycle is the predominant source of urea in air-breathing fishes despite the presence of uricolysis. The significant carbamoyl phosphate synthetase (CPS) levels observed in these fishes may play an important physiological role in their tolerance of high ammonia concentrations. **Further reading.** Saha & Ratha 1998 (ureogenesis).



Shores of Adana reservoir at the Seyhan. A habitat of non-native *Clarias gariepinus*.