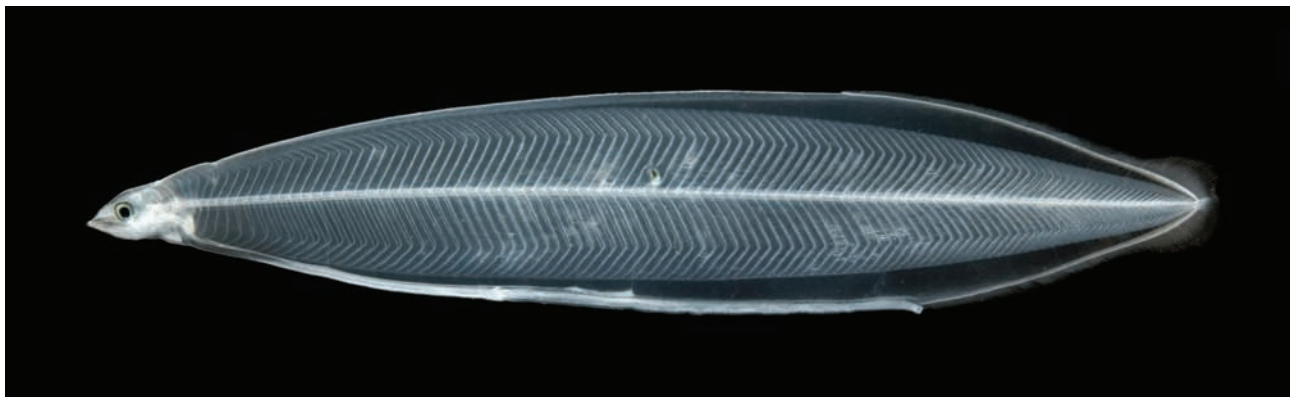


Family Anguillidae

Freshwater eels

Anguilla belongs to Elopomorpha, a basal phylogenetic group that contains various types of fishes. These range from tarpons, ladyfishes, and bonefishes to the large diversity of true eels (Anguilliformes). All members of this group have leptocephalus larvae, unique to the Elopomorpha. *Anguilla* is unmistakably distinct from any other eel-like fishes in freshwaters of West Asia, characterised by the dorsal, caudal, and anal fins being long and confluent and the absence of dorsal spines and pelvic fins. The family is small, with about 15–20 species in a single genus (*Anguilla*). All species are catadromous (freshwater residents migrating to spawn at sea). *Anguilla* is known from all oceanic basins except the Pacific slope of the Americas. All species spawn in warm subtropical areas of deep seas. However, surprisingly little is known about their marine habitat. The European eel *Anguilla anguilla* and the Japanese eel *A. japonica* are the best-studied species.

The reproduction of *A. anguilla* has long been a mystery, given that sexually mature eels have not yet been found. Early ichthyologists were wrong to think that small gobies gave birth to young eels because they mistook parasitic nematodes for eel larvae. Another belief, which lasted until the late 19th century, was that eelpout *Zoarces viviparus* gave birth to small eels. In 1856, *Leptocephalus brevirostris* was first described from the Mediterranean. It was only in 1896 that it was recognised as the larvae of *Anguilla*. Eel larvae are called leptocephalus (plural leptocephali). It was then hypothesised that the spawning sites were in the Mediterranean, but eel larvae smaller than 30 mm TL have never been observed there. In 1904, the first leptocephali were recorded outside the Mediterranean (Faroe Islands). Since then, leptocephali smaller than 7 mm TL and yolk-sack larvae have been observed in the Sargasso Sea. In East Asia and Europe, eels are of major commercial importance, and many threats have caused drastic declines in their population. **Further reading.** Fischer & Bianchi 1984 (identification Indian Ocean); Chen et al. 2014 (Elopomorpha); Nelson et al. 2016 (diversity).



Leptocephalus larvae of an eel; Bermudas; ~100 mm SL. © S. Johnsen.

Key to species of *Anguilla* in West Asia

1a - Dorsal origin slightly in front of anus.

.....*A. bicolor*

1b - Dorsal origin clearly in front of anus.

.....2

2a - Flank plain olive yellowish to dark-brown or black, silvery grey from jaw to anus.

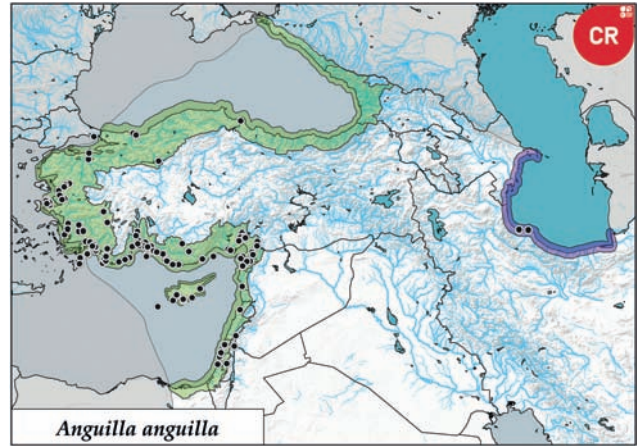
.....*A. anguilla*

2b - Flank mottled in individuals longer than 300 mm TL.

.....*A. bengalensis*



Glass eel of *A. anguilla*; Germany; © J. Simon.



Anguilla anguilla; upper Rhine drainage, Germany; ~600 mm SL. © A. Hartl.

Anguilla anguilla

Common name. European eel

Diagnosis. Distinguished from other freshwater fishes in Mediterranean, Caspian, and Black Sea basins by: ● body very elongate, slender, and cylindrical / ● dorsal, caudal, and anal long and confluent / ● flank plain olive yellowish to dark-brown or black, silvery grey from jaw to anus / ○ dorsal origin clearly in front of anus / ○ pelvic absent. Size usually about 400–600 mm TL, rarely larger, although individuals up to 2000 TL are reported.

Distribution. All rivers flowing to Mediterranean, Black, North, and Baltic Seas and Atlantic as far south as Canary Islands. Stocked in many inland waters and occasionally caught on Caspian coast and in rivers of Iran. Occasional individuals reach Volga drainage through canals. Very rarely in White and Barents Seas, recorded as far east as Pechora. Small numbers enter Black Sea, migrating east to Kuban drainage. Parts of population remain at sea (north-west Atlantic and Mediterranean).

Habitat. All types of benthic habitats, from small streams to banks of large rivers and lakes. Part of population remain at sea. Occurs naturally only in waters connected to sea, stocked elsewhere. Hypothesised to spawn only in

Sargasso Sea, in western subtropical Atlantic (about 26°N 60°W). Spawning area is about 2000 km wide.

Biology. Catadromous. Spawning peaks in early March and continues until July. No concrete data on spawning sites, but presumably at depths of 100–200 m and at about 20°C. Adults die after spawning. Mechanisms by which Leptocephali reach European coasts are not well understood. Evidence shows that larvae swim actively and that drifting plays a minor role. A statistical re-analysis of data does not support the well-known classical scheme of larval migration in Gulf Stream. Leptocephali reach continental slope at about 70 mm and metamorphose into glass eels (almost adult appearance but transparent body), which enter estuaries. Glass eels are observed on Portuguese coast in autumn, in North Sea in winter, and in Baltic Sea in spring. Pigmentation increases during upstream migration, and juveniles are called elvers. Feeding phase lasts 5–8 years for males and up to 12 years or more for females. Males are rarely recorded more than 200 km upstream. Downstream migration begins in late summer or autumn, and adults arrive at spawning sites after spring. In male, eye diameter increases significantly before migration. Migrates in open water layers of ocean, at about 300–700 m depth. Feeds on

a wide variety of benthic organisms. Heavily infected by nematode *Anguillicoloides crassus*, which feeds on blood in swim bladder, this parasite was introduced from Japan with experimental stocks of Japanese eel *A. japonica*.

Conservation status. CR; has strongly declined. Upstream and downstream migration barriers, including mortality from hydroelectric turbines, are a major threat. Furthermore, accumulation of lipophilic chemical contaminants stored by fish and released as fat stores are broken down during migration. These have toxic effects on migrating adults. *Anguillicoloides crassus* is thought to affect ability

of European eel to reach their spawning grounds. European eel is still heavily fished. Exports outside Europe are banned, all trade within Europe (for consumption, culture, and stocking) is regulated, and quotas are in place. However, poaching and illegal trade are believed to occur throughout European eel fishery and are a major wildlife crime.

Further reading. Schmidt 1925 (breeding site); Boëtius & Harding 1985 (migration); Tesch 1991, 1999 (biology); Wirth & Bernatchez 2001 (genetics); Dekker 2003 (decline); Pike et al. 2020a (biology, distribution, conservation status).



Anguilla bengalensis; India; 800 mm TL. © J. Els.



Anguilla bengalensis; India; 800 mm TL. © J. Els.

Anguilla bengalensis

Common name. Mottled Eel

Diagnosis. Distinguished from *A. bicolor* by: ● dorsal origin at about midway between pectoral base and anus, clearly in front of anus / ● mottled colour pattern in individuals longer than 300 mm in TL. Size usually about 800 mm, rarely up to 2000 mm total length.

Distribution. In Arabian Peninsula in Wadi Haj and Wadi Masila in Yemen. Also, in rivers on east coast of Africa, from Pongola in South Africa to Genale in south-west Ethiopia. In Asia and Indian Ocean from Pakistan east to Aceh in Indonesia and peninsular Malaysia. Known to occur on oceanic islands, including Madagascar, Mauritius, Reunion, and others. Unknown if there is one or more spawning grounds in Indian Ocean.

Habitat. Mostly found in lowland and coastal areas, but many individuals migrate far upstream. Most abundant inland eel in India. Juveniles found in habitats with coarse gravel and rocks, often in fast-flowing waters.

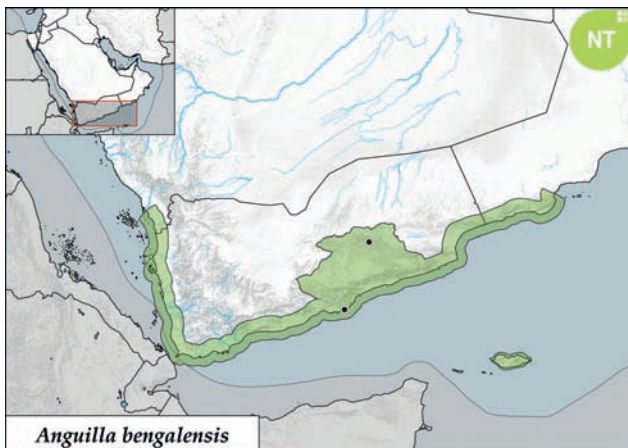
Biology. Catadromous. Adults reach maturity at 5.5–10.5 years and die after spawning. A seaward spawning migration in April and September (Malaysia) suggests a very long spawning season of at least 6 months. Very few leptocephali of this species have been found. Juveniles feed on insects and other aquatic invertebrates, while adults feed on fish and crabs. Considered to be an “unspoiled rare ornamental species of Himalayan drainage,” often kept in temple ponds for religious purposes in India.

Conservation status. NT; although there is little information on population trends, it is believed that range and abundance are declining worldwide due to dam construction. It is also used as a food source, but despite its wide

distribution, there is very little species-specific information on its use and trade, as it is usually lumped together with other eels in catch statistics. Overfishing is a major concern. In some parts of India, it contains levels of contaminants that prove toxic to humans.

Remarks. Often, two subspecies are distinguished: *Anguilla b. bengalensis* in Indian Ocean and *Anguilla b. labiata* in Eastern Africa and the Arabian Peninsula. Both subspecies are treated here as conspecific, but further research is needed.

Further reading. Talwar & Jhingran 1992 (biology, identification); Attaala & Rubaia 2005 (Record from Yemen); Crook & Nakamura 2013 (trade); Jacoby et al. 2015 (threats, conservation); Shiraishi & Crook 2015 (trade); Arai & Abdul Kadir 2017a (distribution, habitats); Arai & Arai Kadir 2017b (spawning); Chai & Arai 2018 (age at maturation); Pike et al. 2020b (biology, distribution, conservation status).



Anguilla bicolor; Thailand; ~400 mm TL. shutterstock_1595226994 dwi putra stock.

Anguilla bicolor**Common name.** Shortfin Eel**Diagnosis.** Distinguished from *A. bengalensis* by: ● dorsal origin slightly in front of anus / ● plain olive yellowish to dark-brown or black, silvery grey from jaw to anus. Size usually about 500–600 mm, rarely up to 1200 mm TL.**Distribution.** In Arabian Peninsula, recorded from Yemen along Arabian Sea and Gulf of Aden but may occur elsewhere in coastal waters. Widespread in Indian Ocean from east coast of Africa to north-west Australia and Greater Sundaland.**Habitat.** Mostly found in lowland and coastal areas, inhabiting estuaries, brackish waters, freshwater lakes, streams, ponds, and small rivers. In Malaysia, 75 % of adults have been found in freshwater, 20 % in coastal seawater, and 5 % in brackish water. Spawns in deep tropical and subtropical oceans.**Biology.** Catadromous. Arabian eels not yet been extensively studied. Live up to 20 years, adults die after spawning. Very little known about marine phase. Leptocephali have never been found, and more information on spawning areas or early life history is needed. Believed to spawn during a broad, prolonged season (data from Sumatra). Migrates downstream in central Vietnam during storm season,

October–December. Feeds on small fish, crustaceans, and molluscs.

Conservation status. NT; due to decline in availability of both *A. japonica* and *A. anguilla* (species traditionally used for aquaculture and consumption), *A. bicolor* is next preferred species for plain eels, driving up demand for this species in East Asia. Although there are very little data available to estimate population changes, it is clear that number of glass eels exported worldwide is increasing rapidly to meet demand. *Anguilla bicolor* can be purchased online from many suppliers. If catches continue to increase at current rates, exploitation is likely to pose a significant threat to populations worldwide, and shortfin eel may soon be listed as an endangered species.**Remarks.** Molecular data suggest that the Indo-West Pacific *A. bicolor pacifica* (from southern China, the Philippines, and the Indonesian islands of Borneo, Sulawesi, and New Guinea) may represent its own conservation unit or an independent species.**Further reading.** Talwar & Jhingran 1992 (biology, identification); Pethiyagoda 1991 (habitat); Chino & Arai 2010 (occurrence in Indonesia); Crook & Nakamura 2013 (trade); Shiraishi & Crook 2015 (trade); Pike et al. 2020c (biology, distribution, conservation status).

Wadi Hadhramaut in Yemen, is the habitat of *Anguilla bengalensis* and several endemic species.