European eel

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The **European eel** (*Anguilla anguilla*)[2] is a species of eel, a snake-like, catadromous fish. They can reach a length of 1.5 m (4 ft 11 in) in exceptional cases, but are normally around 60–80 cm (2.0–2.6 ft), and rarely reach more than 1 m (3 ft 3 in).

Contents

Life history

Much of the European eel's life history was a mystery for centuries, as fishermen never caught anything they could identify as a young eel. Unlike many other migrating fish, eels begin their lifecycle in the ocean and spend most of their lives in fresh water, returning to the ocean to spawn and then die. In the early 1900s, Danish researcher Johannes Schmidt identified the Sargasso Sea as the most likely spawning grounds for European eels.[3] The larvae (leptocephali) drift towards Europe in a 300-day migration.[4] When approaching the European coast, the larvae metamorphose into a transparent larval stage called "glass eel", enter estuaries, and start migrating upstream. After entering fresh water, the glass eels metamorphose into elvers, miniature versions of the adult eels. As the eel grows, it becomes known as a "yellow eel" due to the brownish-yellow color of their sides and belly. After 5–20 years in fresh water, the eels become sexually mature, their eyes grow larger, their flanks become silver, and their bellies white in color. In this stage, the eels are known as "silver eels", and they begin their migration back to the Sargasso Sea to spawn.

Conservation status

The European eel is a critically endangered species.[1] Since the 1970s, the numbers of eels reaching Europe is thought to have declined by around 90% (possibly even 98%). Contributing

European eel

Conservation status

Critically Endangered (IUCN 3.1)[1]

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Anguilliformes
Family:	Anguillidae
Genus:	*Anguilla*
Species:	***A. anguilla***

Binomial name

Anguilla anguilla

(Linnaeus, 1758)

Range for wild European eel

factors include overfishing, parasites such as *Anguillicola crassus*, barriers to migration such as hydroelectric plants, and natural changes in the North Atlantic oscillation, Gulf Stream, and North Atlantic drift. Recent work suggests polychlorinated biphenyl pollution may be a factor in the decline.[5]

Synonyms

Muraena anguilla Linnaeus, 1758
Anguilla malgumora Kaup, 1856

Eels have been important sources of food both as adults (including the famous jellied eels of East London) and as glass eels. Glass-eel fishing using basket traps has been of significant economic value in many river estuaries on the western seaboard of Europe.

In captivity, European eels can live for very long times.[6] According to a report in The Local, a specimen lived 155 years in the well of a family home in Brantevik, a fishing village in southern Sweden.[7]

Sustainable consumption

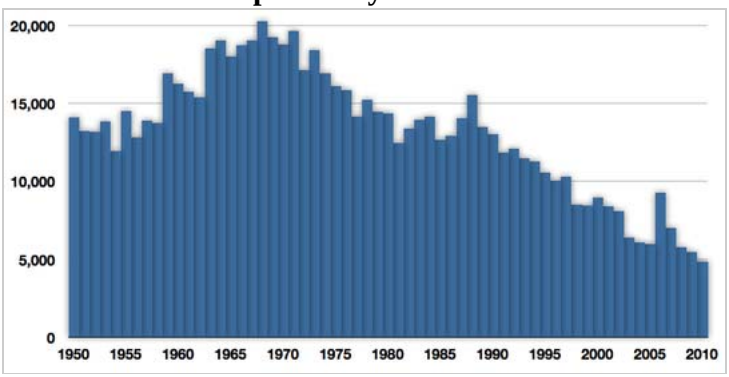
In 2010, Greenpeace International added the European eel to its seafood red list.[8]

Decreasing population numbers and breeding projects

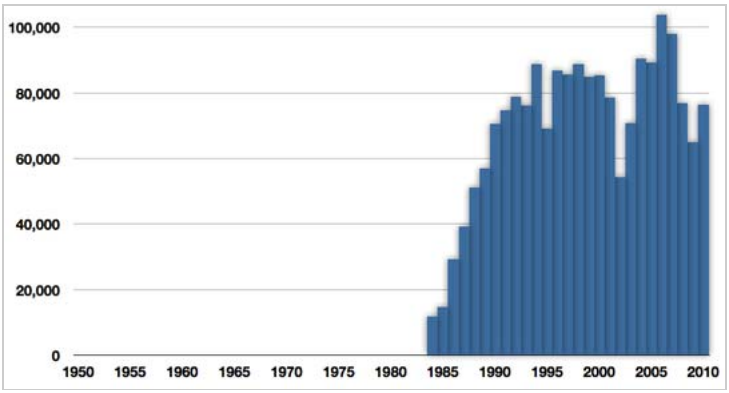
For quite some time, the population number of European eels has been falling, so a research project has been started by Innovatie Netwerk, led by Henk Huizing, to see whether it is possible to breed European eels in captivity. The breeding of European eel is very difficult, since eels are generally only able to reproduce after having swum a distance of 6,500 km (4,000 mi). In the project, this is being simulated by means of a hometrainer for the fish. Innovatie Netwerk has also started a breeding project, called InnoFisk Volendam.[9][10]

Commercial fisheries

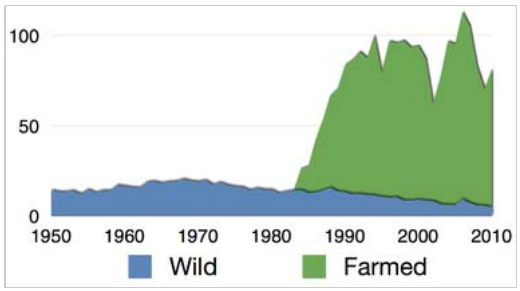
Global production of European eels in tonnes as reported by the FAO



↑ Wild capture, 1950–2010 [11]



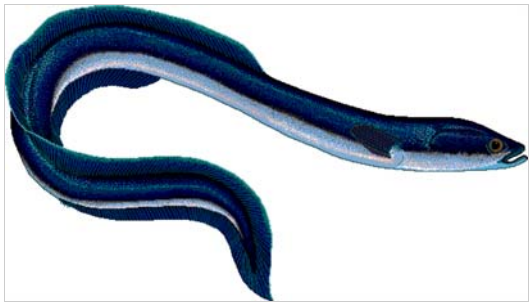
↑ Farmed production, 1950–2010 [11]



↑ Total production of European eel in thousands of tonnes as reported by the FAO, 1950–2010[11]

↑ Main European countries producing farmed European eel

Gallery



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11. Based on data sourced from the FishStat database (http://faostat.fao.org/site/629/default.aspx), FAO.

External links

- Media related to Anguilla anguilla at Wikimedia Commons
- Data related to Anguilla anguilla at Wikispecies
- Froese, Rainer and Pauly, Daniel, eds. (2005). "*Anguilla anguilla*" (http://www.fishbase.org/summary/SpeciesSummary.php?genusname=Anguilla&speciesname=anguilla) in FishBase. 10 2005 version.

Categories: IUCN Red List critically endangered species | Anguillidae | Fish of Europe | Fish of the Mediterranean Sea | Fish of the North Sea | Fish of the Black Sea | Fish of the Baltic Sea | Animals described in 1758 | Amphibious fish | Critically endangered animals

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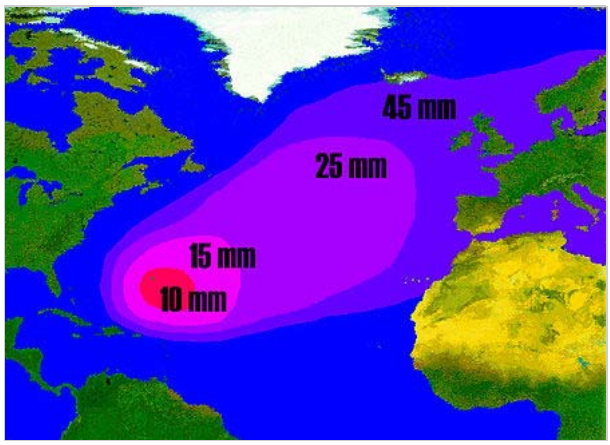
Eel life history

From Wikipedia, the free encyclopedia

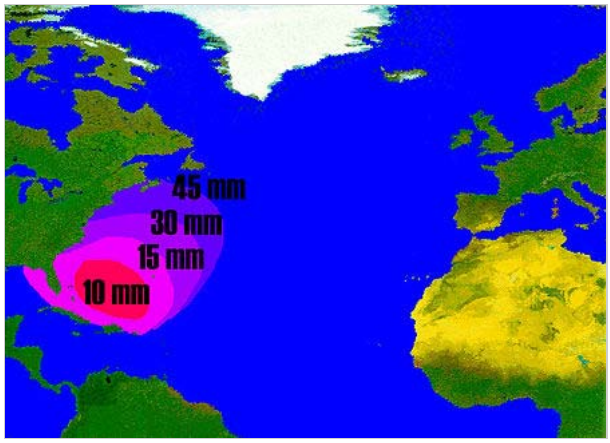
The eel is a long, thin bony fish of the order Anguilliformes. Because fishermen never caught anything they recognized as young eels, the life cycle of the eel was a mystery for a very long period of scientific history. Although there have been more than 6500 publications about eels, much of its life history remains an enigma.

The European eel (*Anguilla anguilla*) was historically the one most familiar to Western scientists, beginning with Aristotle, who wrote the earliest known inquiry into the natural history of eels. He speculated that they were born of "earth worms", which he believed were formed of mud, growing from the "guts of wet soil" rather than through sexual reproduction. Many centuries passed before scientists were able to demonstrate that such spontaneous generation does not in fact occur in nature.

Other early scientists believed that the eelpout *Zoarces viviparus* was the "Mother of Eels" (the translation of the German name "*Aalmutter*").



Distribution and size of leptocephali larvae of the European Eel, *Anguilla anguilla*.



Distribution and size of leptocephali larvae of the American eel, *Anguilla rostrata*

Contents

Past studies of eels

In 1777, the Italian Carlo Mondini located an eel's gonads and demonstrated that eels are a kind of fish. In 1876, as a young student in Austria, Sigmund Freud dissected hundreds of eels in search of the male sex organs. He had to concede failure in his first major published research paper, and turned to other issues in frustration.[1][2][3][4]

Larval eels — transparent, leaflike two-inch (five cm) creatures of the open ocean — were not generally recognized as such until 1893; instead, they were thought to be a separate species, *Leptocephalus brevirostris* (from the Greek *leptocephalus* meaning "thin- or flat-head"). In 1886, however, the French zoologist Yves Delage discovered the truth when he kept leptocephali alive in a laboratory tank in Roscoff until they matured into eels, and in 1896 Italian zoologist Giovanni Battista Grassi confirmed the finding when he observed the transformation of a *Leptocephalus* into a round glass eel in the Mediterranean Sea.

(He also observed that salt water was necessary to support the maturation process.) Although the connection between larval eels and adult eels is now well understood, the name *leptocephalus* is still used for larval eel.

Search for the spawning grounds

Leptocephalus larva of an ocean eel

Glass eels at the transition between ocean and freshwater; the skin is still transparent and the red gills and the heart are visible; length ca. 8 cm

Juvenile eels, length ca. 25 cm

The Danish professor Johannes Schmidt, beginning in 1904, led a series of expeditions into the Mediterranean Sea and the North Atlantic to investigate eels. The expeditions were largely financed by the Carlsberg Foundation. He noted that all the *leptocephali* he found were very similar, and hypothesized that they all must have descended from a common ancestor species. He also observed that the farther out to sea in the Atlantic Ocean he went, the smaller the *leptocephali* he caught were. In a 1922 expedition, he sailed as far as the Sargasso Sea, south of Bermuda, where he caught the smallest eel-larvae that had ever been seen.

Although Schmidt did not directly observe eel spawning, or even find ready-to-spawn adult eels, he was able to deduce the following about the life history of the eel, based on the size distribution of the leptocephali he collected:

The larvae of European eels travel with the Gulf Stream across the Atlantic ocean, and grow to 75–90 mm within one to three years, before they reach the coasts of Europe. Eels in this so-called "recruitment" developmental stage are known as *glass eels* because of the transparency of their bodies. Glass eels typically refers to an intermediary stage in the eel's complex life history between the leptocephalus stage and the juvenile (elver) stage. Glass eels are defined as "all developmental stages from completion of leptocephalus metamorphosis until full pigmentation".[5] The term typically refers to a transparent glass eel of the family Anguillidae.

One well-known location in which the large-scale collection of glass eels takes place (for deli food and stocking) is Epney, on the Severn, in England. (Glass eels are a food item in Spain.) Once they recruit to coastal areas, they migrate up rivers and streams, overcoming various natural challenges — sometimes by piling up their bodies by the tens of thousands to climb over obstacles — and they reach even the smallest of creeks. These are the freshwater eels that spawn in the ocean, and then enter estuaries as glass eels and swim upstream to live in freshwater during their juvenile growth phase. As the glass eels enter freshwaters they start to become pigmented and are typically referred to as elvers. The elvers grow larger and are referred to as yellow eels, which are the juvenile stage of eels before their reproductive maturation begins.

They can propel themselves over wet grass and dig through wet sand to reach upstream headwaters and ponds, thus colonising the continent. In freshwater, they develop pigmentation, turn into *elvers* (young eels) and feed on creatures such as small crustaceans, worms and insects. After 10 to 14 years, they have matured and grown to a length of 60 to 80 cm. At this stage, they are called *yellow eels* because of their golden pigmentation. Marine eels of the order Anguilliformes also have a leptocephalus stage, and likely pass through a stage similar to the anguillid glass eels, but they are rarely seen in the ocean.

In July, some individuals mature and migrate back towards the sea, crossing wet grasslands at night to reach rivers that lead to the sea. Eel migration out of their freshwater growth habitats from various parts of Europe, or through the Baltic Sea in the Danish belts, have been the basis of traditional fisheries with characteristic

trapnets.

How the adults make the 6,000 km (3,700 mi) open ocean journey back to their spawning grounds north of the Antilles, Haiti, and Puerto Rico remains unknown. By the time they leave the continent their gut dissolves making feeding impossible, so they have to rely on stored energy alone.[6] The external features undergo other dramatic changes as well: the eyes start to enlarge in size, the eye pigments change for optimal vision in dim blue clear ocean light, and the sides of their bodies turn silvery, to create a countershading pattern which makes them difficult to see by predators during their long open ocean migration. These migrating eels are typically called "Silver Eels" or "Big Eyes".

The German fisheries biologist Friedrich Wilhelm Tesch, an eel expert and author of the book *The Eel* (ISBN 0-632-06389-0), conducted many expeditions with high-tech instrumentation to follow eel migration, first down the Baltic, then along the coasts of Norway and England, but finally the transmitter signals were lost at the continental shelf when the batteries ran out. According to Schmidt a travel speed in the ocean of 15 km per day can be assumed, so a silver eel would need 140 to 150 days to reach the Sargasso Sea from around Scotland and in about 165 to 175 when leaving from the English Channel.

Tesch — like Schmidt — kept trying to persuade sponsors to provide more funding for expeditions. His proposal was to release fifty Silver Eels from Danish waters, with transmitters that would detach from the eels each second day, float up toward the surface, and broadcast their position, depth and temperature to satellite receivers. He also suggested that countries on the western side of the Atlantic could perform a similar release experiment at the same time. However, even today, only preliminary experiments along these lines have ever been performed.

Our knowledge of what happens to individual silver eels after they leave the continental shelf is based solely on the study of three eels found in the stomachs of deep sea fishes and whales — caught off the coasts of Ireland and the Azores — and on laboratory research into the physiology of eels.

There is another Atlantic Eel species: the American eel, *Anguilla rostrata*. First it was believed European and American eels were the same species due to their similar appearance and behavior, but research has shown that they differ in chromosome count and various molecular genetic markers, and in the number of vertebrae, *Anguilla anguilla* counting 110 to 119 and *Anguilla rostrata* 103 to 110.

The spawning grounds for the two species are in an overlapping area of the southern Sargasso Sea, with *A. rostrata* apparently being more westward than *A. anguilla*, and with some spawning by the American eel possibly even occurring off the Yucatán Peninsula outside of the Gulf of Mexico, but this has not been confirmed. After spawning in the Sargasso Sea and moving to the west, the *leptocephali* of the American eel exit the Gulf Stream earlier than the European eel and begin migrating into the estuaries along the east coast of North America between February and late April at an age of about one year and a length of about 60 mm.

The spawning area of the Japanese eel, *Anguilla japonica*, has also been precisely located to be to the west of the Suruga seamount[7] and their leptocephali are then transported to the west to East Asia by the North Equatorial Current. Furthermore, in June and August 2008, Japanese scientists discovered and caught matured adult eels of A. japonica and A. marmorata in the West Mariana Ridge.[8]

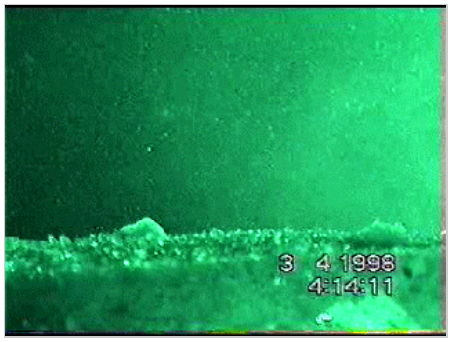
Southern Africa's four species of freshwater eels *(Anguilla mossambica, Anguilla bicolor bicolor, Anguilla bengalensis labiata,* and *Anguilla marmorata)* have a very interesting migratory pattern. It takes them on a long journey from their spawning grounds in the Indian Ocean north of Madagascar to high up in some of the Southern African river systems and then back again to the ocean off Madagascar.[9]

Decline of the glass eels

No one yet knows the reasons, but beginning in the mid-1980s, glass eel arrival in the spring dropped

drastically — in Germany to 10% and in France to 14% of their previous levels — from even conservative estimates. Data from Maine and other North American coasts showed similar declines, although not as drastic.

Glass eel on the online *in situ* microscope at the LEO project.



Glass eel

In 1997 European demand for eels could not be met for the first time ever, and dealers from Asia bought all they could. The traditional European stocking programs could not compete any longer: each week the price for a kilogram of glass eel went up another US$30. Even before the 1997 generation hit the coasts of Europe, dealers from China alone placed advance orders for more than 250,000 kg, some bidding more than $1,100 per kg. Asian elvers have sold in Hong Kong for as much as $5,000 to $6,000 a kilogram at times when $1,000 would buy the same amount of American glass eels with gunfights at their catching sites.[10] Such a kilogram, consisting of 5000 glass eels, may bring at least $60,000 and as much as $150,000 after they leave an Asian fish farm. In New Jersey over 2000 licences for glass eel catch were issued and reports of 38 kg per night and fisherman have been made, although the average catch is closer to 1 kg.

The demand for adult eels has continued to grow, as of 2003. Germany imported more than $50 million worth of eels in 2002. In Europe 25 million kg are consumed each year, but in Japan alone more than 100 million kg were consumed in 1996. As the European eels become less available, worldwide interest in American eels has increased dramatically.

New high-tech eel aquaculture plants are appearing in Asia with detrimental effects on the native Japanese eel, *Anguilla japonica*. Traditional eel aquaculture operations rely on wild-caught elvers, but experimental hormone treatments in Japan have led to artificially spawned eels. Eggs from these treated eels have a diameter of about 1 mm, and each female can produce 2 to 10 million eggs.

Threats to eels

There are strong concerns that the European eel population might be devastated by a new threat: *Anguillicola crassus*, a foreign parasitic nematode. This parasite from East Asia (the original host is *Anguilla japonica*) appeared in European eel populations in the early 1980s. Since 1995, it also appeared in the United States (Texas and South Carolina), most likely due to uncontrolled aquaculture eel shipments. In Europe, eel populations are already from 30% to 100% infected with the nematode. Recently, it was shown that this parasite inhibits the function of the swimbladder as a hydrostatic organ (Wuertz *et al.*, 1996).

As an open ocean voyager, eels need the carrying capacity of the swimbladder (which makes up 3–6% of the eel's bodyweight) to cross the ocean on stored energy alone.

Because the eels are catadromous (living in fresh water but spawning in the sea), dams and other river obstructions can block their ability to reach inland feeding grounds. Since the 1970s an increasing number of eel ladders have been constructed in North America and Europe to help the fish bypass obstructions.

In New Jersey, an ongoing project monitors the glass eel migration with an online *in situ* microscope. As soon as more funding becomes available, it will be possible to log into the system via a Longterm Ecological Observatory (LEO) site.

See also

- Eel ladder
- Fish migration

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External links

- The Maine Eel and Elver Fishery Maine Department of Marine Resources (http://www.maine.gov/dmr/rm/eel.html)
- Fishbase entry for *Anguilla anguilla* (http://filaman.uni-kiel.de/Summary/SpeciesSummary.cfm?ID=35&genusname=Anguilla&speciesname=anguilla)
- Fishbase entry for *Anguilla rostrata* (http://filaman.uni-kiel.de/Summary/SpeciesSummary.cfm?ID=296&genusname=Anguilla&speciesname=rostrata)
- ICES report about eel stock collapse (http://www.ices.dk/marineworld/eel.asp)
- U.K Glass Eels — a large commercial firm's website, with history and fact pages (http://www.glasseel.com/)
- Projekt eelBASE (http://web.archive.org/web/20001027080113/www.ecoscope.com/eelbase.htm)

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