



## Cultured Aquatic Species Information Programme

*Anguilla anguilla* (Linnaeus, 1758)



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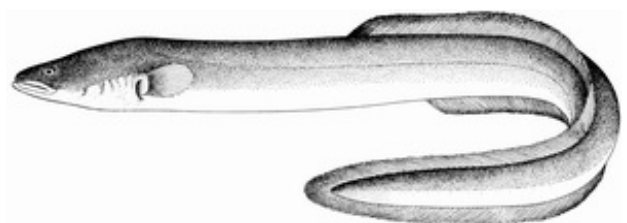
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## Identity

***Anguilla anguilla* Linnaeus, 1758 [Anguillidae]**

FAO Names: En - European eel, Fr - Anguille d'Europe, Es - Anguila europea



### Biological features

Body elongate, cylindrical anteriorly, somewhat compressed posteriorly. Head rather long. Eye always rounded, small in young and yellow eels, large in silver eels. Lower jaw longer than the upper and protruding. Teeth minute, set in bands in both jaws and in a patch on vomer. Gill openings small and vertical, restricted to sides. Dorsal and anal fins confluent with caudal fin; the dorsal fin originates far behind the pectorals; anal fin origin slightly behind anus, well back from origin of dorsal fin. Pectoral fins small and rounded. Pelvic fins absent. D:245-275; A:205-255; Vertebrae: 110-119. Lateral line conspicuous. It has minute, elliptical scales embedded in the skin. Adults in freshwater are greenish-brown on black, yellowish on belly (yellow eel stage), changing to blackish on back and bright silvery on sides and belly (silver-eel stage during spawning migration). Leptocephali and glass-eel stage transparent, elvers greenish-brown; very rarely orange coloured specimens are reported.

[View FAO FishFinder Species fact sheet](#)

### Images gallery



*Anguilla anguilla*



*Glass eels (Tesch, 2003).*

## Profile

### Historical background

In Italy, West Germany and Denmark an extensive culture of European eel in ponds occurred up to the 1970s. However, due to the short summer period (e.g. Denmark) profitable production was impossible.

The development of farm systems with heated water was developed in the late 1970s in order to farm the eel at its optimum temperature (24-26 °C). The use of indoor systems started experimentally in Europe in the 1970s. Commercial utilisation started in northern Europe, mainly in the Netherlands, Denmark and Germany in the early 1980s.

Nowadays, European eel farming is mainly associated with recirculation systems. These techniques are especially used in Denmark, Italy and the Netherlands, and have resulted in highly intensive farming conditions.

European eel production is based on the import of glass eels from France, Portugal, Spain and the United Kingdom.

Total production of European eel is expected to be >10 500 tonnes, with the Netherlands being responsible for approximately 50 percent of this total.

### Main producer countries

Currently, the top three producing countries of farmed European eels are the Netherlands, Italy, and Denmark. Spain, Greece, Sweden and Germany are also centres of eel farming activity and smaller quantities are produced in several other European and North African countries.



Main producer countries of *Anguilla anguilla* (FAO Fishery Statistics, 2006)

## Habitat and biology

The European eel is a catadromous and carnivorous species. Young eels live in freshwater, where they stay for a period of 6-12 years for males and 9-18 years for females. As the eels become sexually mature they migrate to the sea, where they move to the spawning grounds in the Sargasso Sea. During migration the eels do not feed.

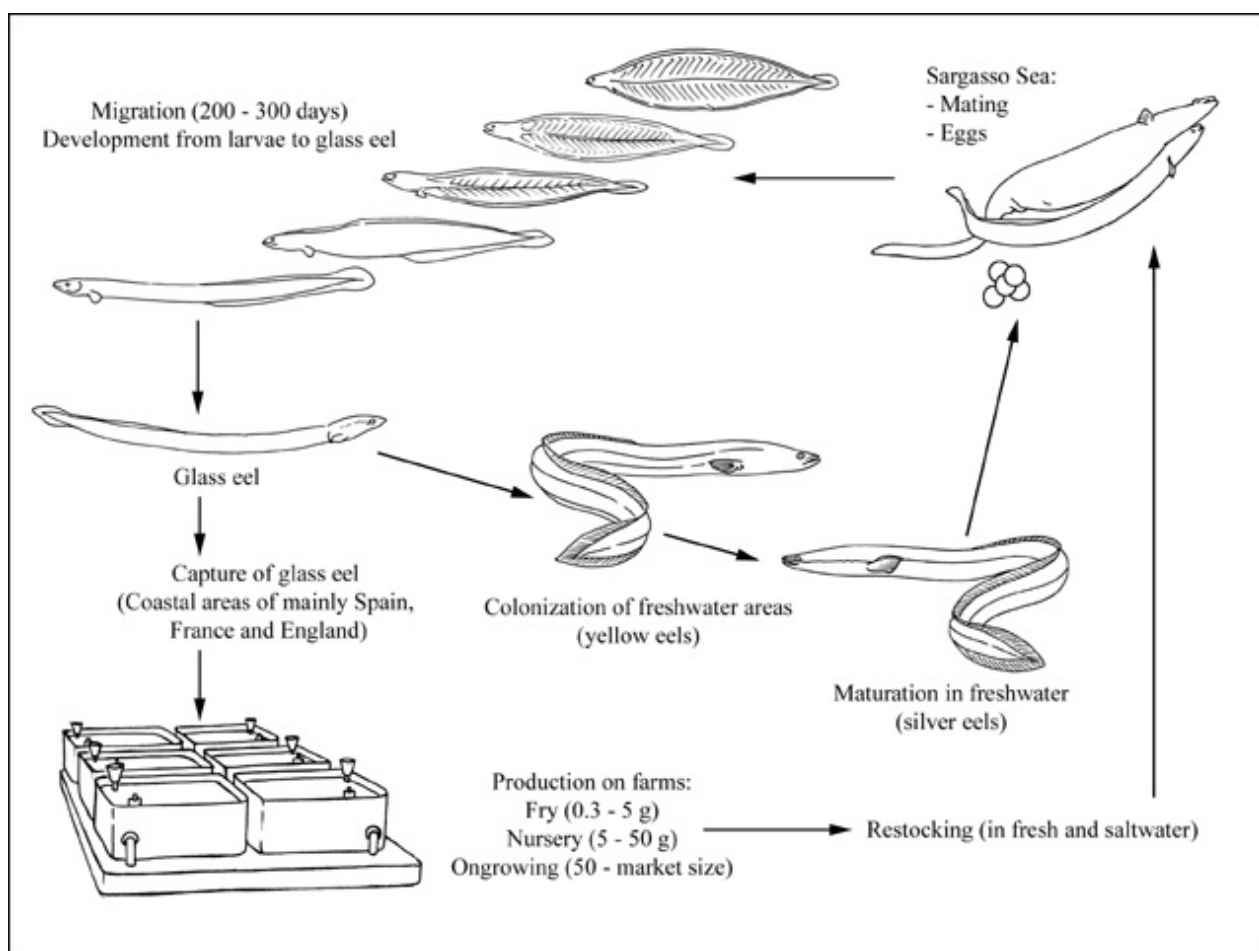
Once in the Sargasso Sea the eels spawn in late winter and spring. Adult eels do not leave the Sargasso Sea but their progeny, the leaf-shaped larvae (leptocephali) are brought to the continental shelf of Europe by the Gulf Stream, a journey that takes 200-300 days.

Before entering coastal zones and estuaries the larvae metamorphose into transparent eels (glass eels). As the eels colonize the freshwater areas of Europe they are known as yellow eels (pigmented eels). During the last summer of their freshwater life, eels become sexually mature and silvery in appearance (silver eels). At this stage their eyes become bigger, their heads broader and the content of body fat increases.

The European eel is found in rivers draining into the North Atlantic, Baltic and Mediterranean Seas. It is also distributed along the coast of Europe from the Black Sea to the White Sea.

## Production

### Production cycle



*Production cycle of Anguilla anguilla*

## Production systems

Production of eels is based on wild catches of glass eels (elvers) used for further ongrowing. Extensive culture of European eels under natural conditions has diminished to a level of no commercial importance. Intensive production by the use of recirculation technology, keeping water temperatures stable around 24 °C, has become the overall production method.

### Seed supply

Glass eels are captured around the shores of France, Portugal, Spain and the United Kingdom and either used nationally or exported to eel farmers in other countries. Some glass eel fishing in Spain and Portugal uses scoop nets and traps. In France they are caught by small trawlers using wing nets and trawls. The only legal fishing gear for this purpose in the UK is the scoop net.

### Nursery

At first the glass eels (~0.33 g each) are kept in smaller tanks of 3-4 m<sup>2</sup> for quarantine purposes. The density at this stage is 10-15 kg/m<sup>2</sup>. The eels are examined for diseases and, following diagnosis, treated. The eels are also weaned to artificial diets with cod roe and, later on, dry starter feed.

When the eels reach approximately 5 g they are transferred to a juvenile production unit with larger tanks (6-8 m<sup>2</sup>) and stocking densities (50-75 kg/m<sup>2</sup>). At this point the eels can digest dry feed pellets (1 mm).

### Ongrowing techniques

#### Extensive pond systems

The traditional form of eel culture in Europe is in ponds of about 100-350 m<sup>2</sup>. When eels reach marketable size they are transferred to larger ponds (1000-1500 m<sup>2</sup>). The ponds may be static or flow-through. The best temperature range in ponds is 18-25 °C.

These systems consist of square or circular tanks from 25-100 m<sup>2</sup>, usually built of cement or fibreglass. The eels are stocked at a size of 50 g. Densities reach up to 100-150 kg/m<sup>2</sup>. Extruded dry feed (1.5-3 mm) is fed automatically several times a day. Individual growth rates are very different, and grading every 6 weeks is necessary in order to reach a high overall growth performance.

#### Valliculture

Eels are also extensively cultured in marine and brackish waters within a form of aquaculture known as *valliculture*. In these Mediterranean systems, mainly in Italy, in the north Adriatic, elvers of 15-35 g are stocked at the rate of 4-15 kg/ha. The elvers are mainly imported from France but also from Denmark, the Netherlands and Sweden.

#### Feed supply

Almost all forms of intensive culture use formulated feeds in the form of a moist paste for glass eels and steam-pressed or extruded pellets for the later stages. Several European aquafeed manufacturers produce eel feeds.

#### Harvesting techniques

Partial harvesting and grading are important facets of successful eel farming. The actual technique used is simple but care is necessary to minimize stress. Feeding is stopped minimum 1-2 days before grading or harvesting. Eels are led passively through a pipe from the rearing tank to a grading machine. Eels large enough for the market are dealt with as indicated in the following section of this fact sheet. Eels that have not reached market size are returned to the rearing tanks for further on-growing. During harvesting, care is taken to keep oxygen levels high.

#### Handling and processing

After harvesting, eels are rapidly sorted into different sizes, using grading systems. They are kept in holding tanks without feed for several days to purge their stomachs and eliminate possible off-tastes. If they are to be consumed fresh, they are chilled, packed into strong oxygenated plastic bags with just enough water to ensure that the skin remains moist, and transported to market. If they are destined for processing they are transported live to the processing plant. Most Danish farmed eels are smoked at Dutch processing plants, while a smaller part is skinned in Denmark for frying.

#### Production costs

The cost of elvers varies significantly depending on annual catches and the interest from Asian eel producers, who buy European eels for farming in their home countries. Prices during 2004 varied between 300.00 and 750.00 EUR/kg.

General over all production costs in recirculation systems of about 6.00 EUR/kg have been reported (2003) from Denmark.

### Diseases and control measures

European eels are susceptible to numerous parasites, fungi, bacteria, and viruses that can cause disease outbreaks. However, in aquaculture only a few disease agents result in disease outbreaks that decrease growth or increase mortality. Commonly seen disease agents are listed in the following table.

In some cases antibiotics and other pharmaceuticals have been used in treatment but their inclusion in this table does not imply an FAO recommendation.

DISEASE	AGENT	TYPE	SYNDROME	MEASURES
Red fin disease	<i>Aeromonas hydrophila</i>	Bacterium	Tail rot; fin rot; haemorrhagic septicaemia	Improved water quality; NaCl (0.5-0.9%)

Red eel pest	<i>Vibrio anguillarum</i>	Bacterium	Red spots on ventral & lateral areas; swollen & dark skin lesions that ulcerate	Antibiotics
Viral diseases (Red head)	Herpes & Rhabdoviruses	Viruses	Haemorrhages around the head and operculum initially; later spread to the whole body	Vaccination with infected fingerlings from preceding year; decreased temperature (18-20 °C); NaCl (0.1%)
Fungal infections	<i>Saprolegnia</i> spp.	Fungi	White to brown cottony or hairy patches on the skin, fins and gills; death may occur if gills obstructed; usually secondary infection.	NaCl (0.1%)
	<i>Dermocystidium anguillae</i>	Sometimes classed as a protozoan but probably a fungus	Swellings on gills, fins or body	None - removal of infected eel
Parasitic infections	<i>Pseudodactylogyrus anguillae</i> ; <i>P. bini</i>	Monogeneans	Invade the gills; respiratory distress	Formaldehyde (24%) - 60 ppm; Mebendazole
	<i>Trichodina</i> spp.	Ciliates	Flashing; lethargy; increased mucus production; sometimes ulcers and frayed fins; respiratory distress if gills affected	Formaldehyde (24%) - 60 ppm
	<i>Ichthyophthirius multifiliis</i>	Protozoan	White patches on body; becoming lethargic; attempt to remove parasites by rubbing on enclosure surfaces	NaCl (1%)

#### Suppliers of pathology expertise

Assistance can be obtained from the following sources:

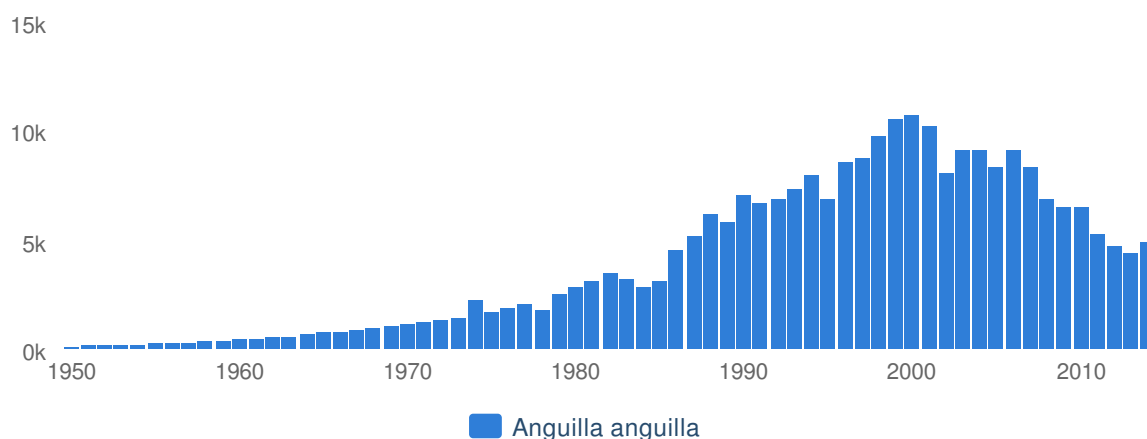
1. Professor Kurt Buchmann, Royal Veterinary and Agricultural University, Stigbøjlen 4, Dk-1870 Frederiksberg C, Denmark.
2. Dr. Inger Dalsgaard, Danish Institute for Fisheries Research, Fish Disease Laboratory, Stigbøjlen 4, Dk-1870 Frederiksberg C, Denmark.

## Statistics

### Production statistics

## Global Aquaculture Production for species (tonnes)

Source: [FAO FishStat](#)



In 2002, the top three producing countries of farmed European eels were the Netherlands, Italy, and Denmark. Substantial quantities are also farmed in Spain, Greece, Sweden and Germany, together with smaller quantities in several other European and North African countries, including Algeria, Hungary, Macedonia, and Morocco.

### Market and trade

Eels are normally sold at two size ranges for smoking; either at 120-180 g, which is the normal Dutch smoking size, or at 300-600 g (large smoking size) in Germany. A smaller amount is fried or jellied or stewed. More specialised processed products include the Japanese specialty "kabayaki" [a style of serving, in which eels of around 150-200 g are butterflied, placed on skewers, basted and marinated in a thick soy-based sauce, and steamed or grilled; over 90 percent of all global production of eels (all *Anguilla* spp.) is destined for this form of consumption].

### Status and trends

European aquaculture can currently be considered a mature technology. It seems likely that the industry will see little further expansion, and few new production units are expected to be constructed. There is a shortage of elvers and considerable resistance to their extraction from the wild for farming purposes.

Research and development efforts for the European eel are required in the following areas:

- Enhancing the sustainability of the wild population.
- Hatchery production of larvae, aimed at producing a stable and high quality supply.
- Improvements in culture systems and automation, as well as improved management.
- Disease prevention and control.
- Improved marketing, with the consolidation of existing markets and development of new markets.
- Training technical personnel with combined skills in aquaculture technology and business management.

### Main issues

Eel farmers are primarily concerned about the future access to elvers as these catches may be regulated heavily in order to protect the wild eel population. Ongrowing of elvers for restocking of small eels is, however, used in the effort to support the wild stocks. Although some claims to success on a laboratory scale have been made, commercial reproduction of the European eel in captivity has not yet been successful, and is unlikely to become so in near future.

### Responsible aquaculture practices

Eel culture should follow the tenets of the following codes:

European Aquaculture Code of Conduct (FEAP).

Code of Conduct for Responsible Fisheries (FAO).

## References

Bibliography
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Ottolenghi, F., Silvestri, C., Giordano, P., Lovatelli, A. & New, M.B. 2004. Eels. In: Capture-based aquaculture – the fattening of eels, groupers, tunas and yellowtails, pp. 21-67. FAO, Rome, Italy.

Tesch, F.W. (Thorpe, J.E., ed.). 2003. The eel, 5th ed. Blackwell Science, Oxford, England. 408 pp.

Walton, I. 1897. Observations of the Eel, and other Fish that want Scales; and how to fish for them. In: The Compleat Angler, pp. 195-204. John Lane the Bodley Head, London, England.

Related links
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[Aquafind](#)

[Aquatic Animal Pathogen and Quarantine Information System - AAPQIS](#)

[Aquatic Network](#)

[Database on Introductions of Aquatic Species - DIAS](#)

[European Aquaculture Society - EAS](#)

[FishBase](#)

[FAO FishStatJ – Universal software for fishery statistical time series](#)

[GLOBEFISH](#)

[Network of Aquaculture Centres in Asia-Pacific - NACA](#)

[World Aquaculture Society - WAS](#)

