

SPAWNING AND LARVAL DISPERSION

The European eel (*Anguilla anguilla*) occurs in fresh and brackish waters in almost all of Europe (including the Baltic and Mediterranean) and in Northern Africa. The entire life cycle of the eel is not fully understood but eel eggs are found in spring and early summer in the Sargasso Sea between Bermuda and Cuba. Within a few days the eggs metamorphose into transparent blade shaped larvae (Leptocephalus) which drift to Europe on the Gulf Stream, eventually metamorphosing into 5cm long colourless "Glass Eels" after 8-9 months. The Gulf Stream scatters eels from Morocco to Iceland, with eels first appearing in the Southern distributions of Europe and arriving in Britain in 190-280 day after spawning. Due to the scattering of eels across Europe from one spawning ground, all European eels are considered to be from one stock (Panmictic), as their genetics recently confirms.

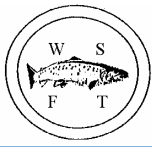
ELVERS AND YELLOW EELS

Glass Eels start to arrive in the coastal waters of Britain in February and by May most assume a yellow-brown colour which distinguishes them as "Elvers" (5-10cm or 2500/kg). Between March and July Elvers ascend estuaries and rivers normally in waves of upstream invasions, by actively 'riding' Spring tide surges, with a peak of Elvers usually in May. Once in fresh water the Elvers reside downstream for the first year and start a series of metabolic changes and turn olive-brown or gray-brown on top with a silver or yellow-silver belly by 13cm, at which point they are considered to be "Yellow Eels" and fully adapted to life in fresh water. These metabolic changes include the production of slime, an ability to breathe through the skin and the production of a toxin to deter fish predators.

ECOLOGY OF YELLOW EELS

Yellow eels progressively migrate upstream with age/size and as male Yellow eels mature at a smaller size to females, larger older eels further up stream tend to be female. Yellow eels spend most of their time lying flat on mud or with the upper part of their body upright, or lying in holes. In colder climates such as Scotland yellow eels often hibernate over winter.

Yellow eels are benthic nocturnal feeders, with small eels feeding on small invertebrates in shallow habitats with abundant aquatic vegetation and large eels (30-



40cm+) preying on larger invertebrates and fish in deep water with little aquatic vegetation. However, in the acidic watercourses of the Highlands, eels tend to eat more fish due to lower number of large invertebrates. With scarcer food and a cooler climate, Highland eels grow at a slow rate and maturing at older age. This has the effect of allowing a large number of age classes of eels (decades of eels) to be present in one watercourse. Such a situation is not possible in most of Europe where better food availability or higher temperatures can cause eels to mature within a couple of years. Due to this, stocks in cooler climates may be important 'gene banks', maintaining a healthy high genetic diversity in the Panmictic eel stock by retaining the genetics of a year class that may have been 'fished out' years before in Europe. In addition, these cooler climate stocks may buffer against sequential years of natural low production of eels due to climatic variation.

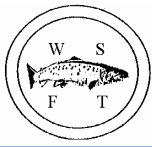
Eels also form an important food source for Cormorants, Herons, Bittern, Osprey, gulls and Otters (all unaffected by the fish toxin) which select eels in preference to trout and salmon. Due to the eels multiple interactions with the surrounding ecosystem eels are considered to be an important nutrient flux and a keystone species, supporting important and protected species.

SILVER EELS

Once yellow eels have stored sufficient body fat (10% of body weight) yellow eels mature into Silver eels (UK: males 30-50cm, 7-20y; females 50-100cm, 9-50y), with Highland eels maturing at the older ages (maximum recorded age of 85y - 7¾ lb). Silver eels are dark grey-green on top and silver flanks and belly, developing spherical large diameter eyes for vision in deep ocean waters and large pectoral fins. Silver eels reduce feeding as they self digest their own gut and gonads start primary development.

MIGRATION

On moonless nights during late August and October, silver eels migrate down river and out to sea, sometimes across short distances over land. Currently there is no knowledge of Silver eel movements from leaving the coast until finding eggs in Sargasso Sea. Laboratory experiments have shown that Silver eels have heightened magnetic orientation in autumn in the direction of the Sargasso Sea and have the capacity to utilise their fat reserves to swim constantly for at least 6-7 months. As Silver eels have rarely been caught at sea they are thought to swim at depths below



200m, where they would catch the cold Canaries current (<10°C). At this temperature gonad development would be sufficiently slow to keep the eels streamline enough to make the Sargasso Sea within 6-7months. This hypothetical migration would place them in the Sargasso Sea in March-June in time for spawning.

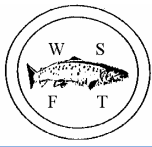
Silver eels on reaching the Sargasso Sea would pass through a convergence zone, where warm southern water collides with colder Northern waters. On crossing into the warmer water an odour imprint similar to salmon may cause eels to stop migrating and gonads would rapidly develop, releasing pheromones causing eels to aggregate and spawn. Spawning is believed to occur around 100-300m, with each female producing 2 to 10 million eggs, after which the eels die.

NEED FOR MANAGEMENT AND LEGISLATION

Since 1999 European researchers have insisted that “Eel stocks are outside sustainable limits”, with a drop of 99% in European stocks since 1980’s. The decline has been attributed to fishing, with a drop of UK Elver catches to 1% over the last 20 years and European Silver eel fishing allowing less than 3% of the stock returning to the sea each year. However, research on the river Severn suggests that current levels of Elver fishing may not affect the river eel population as the rivers can only support a finite population of Yellow eels which is far exceeded by the supply of elvers. Additional causes of stock decline have been attributed to climate change, pollution, habitat destruction and disease.

With the above evidence the European Union has produced a Council Regulation (EU No. 1100/2007 of 18 September 2007 Establishing measures for the recovery of the stock of European eel) to ensure 40% silver eel escapement (based on unfished stock levels), through the implementation of river basin Eel Management Plans by 2009 and closure of fisheries if unsuccessful by 2015. Eel management plans must: indicate limits on commercial activity, habitat conservation, restocking measures, structures to facilitate migration and aquaculture measures; either reduce fishing effort by at least 50% of 2004-2006 levels or reduce other anthropogenic mortality factors equivalent to catches; retain 60% of eel catches less than 12cm long for restocking by 2013; and must establish full traceability on eel catches and trading by July 2009. Implementation will be through Fisheries Research Services.

In addition, eels are covered under Water Framework Directive (WFD), where specific extensions could be implemented for eels as an indicator of river connectivity and



ecological and chemical status. The WFD would be implemented through SEPA and SNH.

