



The eel is slipping away

It is now or never for the eel. Catches are falling and only small numbers of young eels are trickling into the Netherlands, while locks and pumping stations prevent the adults from reaching the sea. Will a fishing ban save the eel?

TEXT HANS WOLKERS PHOTOGRAPHY HOLLANDSE HOOGTE AND GETTY IMAGES ILLUSTRATION SCHWANDT INFOGRAPHIC

Aren't they beautiful, they swim so gracefully!' Researcher Christian Tudorache gazes enthralled at a fat eel in a plexiglass tank full of water. The creature is a picture of grace and elegance as, fins rippling, it swims in practically perfect S formations. The eel researcher, based at the University of Leiden, is trying to solve one of the many mysteries surrounding this fish. 'According to biomechanical calculations, eels are incredibly inefficient swimmers', says Tudorache. 'It seems impossible that they could make the journey to their breeding grounds, about 6,000 kilometres away, without eating and simply by living off their fat reserves.' But when the researchers got their eels to swim this astonishing distance in the tunnels, they turned out to use at least five or six times less energy than trout do. 'Nobody knows how they do it; that is what we are trying to find out.' The eel is an enigmatic creature at the best of times. In spite of all our technological expertise, the life cycle of the eel remains shrouded in mystery. Young eels, known as glass eels, migrate from the sea into the inland waters

of Europe and stay there for about fifteen years, until they reach adulthood. Then they return to the sea to breed. And that is as far as our knowledge of their life cycle takes us. We are not even sure about the location of the eels' breeding grounds. It is thought to be somewhere in the Sargasso sea, where eel larvae have been spotted (see text box).

EEL CRISIS

The eel is in trouble. Big trouble. The numbers of eels migrating into Europe have reached an all-time low. According to researcher Martin de Graaf of IMARES, part of Wageningen UR, they are now at about one percent of the numbers of thirty years ago. Eel catches have also fallen dramatically. Catches by a group of fishers selected for a study dropped steadily from 1994, going down to 30 percent of the starting levels. And the numbers of eels sold at the fish markets around the IJsselmeer lake dropped by more than 90 percent in ten years. And the European eel is not the only problem case. The American and Japanese >

eel populations are in sharp decline too. The European eel crisis started more than a century ago, but the decline went almost unnoticed at the time. Not least because key episodes in the life cycle of the eel, its migration and reproduction, are not visible to us. It was only in the nineteen eighties, when the migration of glass eels into Europe took a dive, that alarm bells began to ring. Scientists and fishers urged governments to take action, but to no avail, at least until quite recently. It was only in 2009 that government bodies took up the cudgels: the EU insisted on its member states coming up with concrete 'eel management plans'. At this point the norm was adopted that at least 40 percent of the adult eels should be able to migrate to the sea to breed.

SAVING SILVER EELS

So the Dutch government, too, was forced to take the eel problem seriously. Given that the Dutch eel fisheries are by far the largest in Europe, with 200 companies netting 920 tons of eel per year, a seasonal fishing ban seemed an obvious option. The then minister of Agriculture, Nature and Food Quality did indeed impose a ban on eel fishing from September to November. The ban is on the agenda for this year again. These months are the period when the adult eels, known as silver eels, migrate from the freshwater rivers out to sea and on to their breeding grounds. And it is saving these fish that can be effective. The trouble is that these are precisely the three months in which fishers can net 70 percent of their annual catch. Arjan Heinen, advisor on fisheries management at the *Combinatie van Beroepsvissers*, an umbrella organization for professional groups in the sector, is doubtful about the effectiveness of a fishing ban. 'The river eel in particular is so badly polluted with chemicals that it is very doubtful whether it is able to breed successfully', he says. 'Eels in the polders are much cleaner, but they cannot get away into the sea because of the countless weirs and pumping stations.'

Some scientists are sceptical too. 'The main reason for the fishing ban is that people are walking around with blinkers on and do not see that there are several reasons for the decline of the eel', claims eel expert Guido van den Thillart, from the University of Leiden, who thinks it is therefore pointless to target the fishers alone. He sees urbanization and the destruction of eel habitats that go

with it as a major factor in the eel problem: migration routes get closed off, water meadows are flooded less often, and canalizing rivers makes them flow faster, washing away nutrients, which is bad for eels. 'It is no coincidence that the three eel species which have suffered the biggest decline are the ones that come from the most urbanized areas', he states. 'Break down the *Afsluitdijk* and return the IJsselmeer lake to the sea, and you would do more to help restore eel stocks.' According to Johan Verreth, professor of Aquaculture and Fisheries at Wageningen University, part of Wageningen UR, the eel debate is not being conducted very rationally, and too many assumptions are being made about the fish. Besides factors related to the inland waterways, such as locks and pump houses which stop the eel from migrating, there could be factors in the sea that play a role. Hardly anything is known about what goes on there. Are ocean currents or water temperatures altered by climate change? We are still only guessing. Verreth too is convinced that there are multiple factors involved in the decline of eel populations. 'Politicians are passing a disproportional amount of the blame on to the eel fisheries', he says. 'I am not against a temporary ban on fishing silver eel, but it might be far more effective to solve the problems surrounding migration.'

VALUABLE FISH

IMARES researcher Stijn Bierman thinks there is something to be said for a temporary ban on fishing eels that are on their way to their breeding grounds. 'The migrating silver eels are very valuable fish; they are the survivors', says the population ecologist. 'You can assume that the fishing ban will contribute to an increase in the numbers of migrating silver eels.' The Dutch eel management plan is based on scientific calculations that show that in the long term, limiting eel fishing is an effective measure for making sure that larger numbers of the fish reach the sea. A Europe-wide fishing ban would mean that about 320 tons of silver eel would reach the sea in 2012. The figure would eventually reach almost 2,000 tons, albeit only in 2090. On the basis of these figures, the Worldwide Fund for Nature (WWF) is a strong supporter of the fishing ban. In fact, the organization would like to see eel fisheries closed down for good. 'It is irresponsible to go on fishing a species that is as seriously threatened as this one', says Carel Drijver, head of the Oceans and Coasts programme at the Dutch branch of WWF. He points to findings by scientists from IMARES: more than 60 percent of the adult eel deaths, well over 900 tons per year, can be put down to fishing. And that is without counting the unbridled fishing of glass eels in France and Spain. Until recently as much as 97 percent of the glass eels there were caught for consumption or for fattening up in fish farms. A large number were exported to China as well. This is banned from 2012. >

'Politicians are putting too much of the blame on the eel fisheries'

THE EUROPEAN EEL

The European eel is found in large areas of Europe and North Africa in all kinds of waters. Eels have a preference for water with muddy beds and plenty of hiding places. They are largely nocturnal and hunt riverbed creatures. During wet weather, eels can cross land barriers.

The eel has a flexible body and a slimy skin, and is usually brown in colour



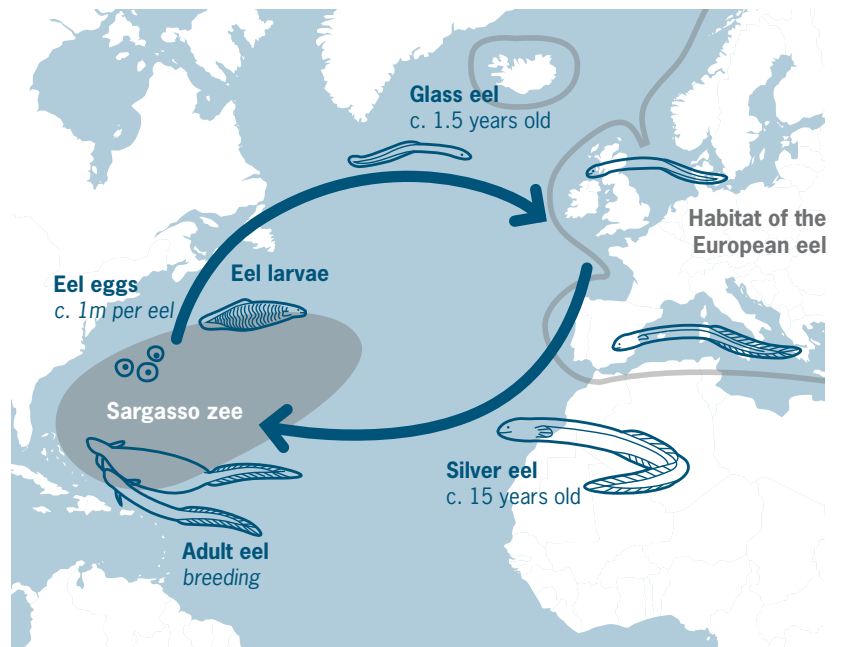
← The eel can reach lengths of more than 1 metre →

Life cycle

It is assumed that at some point between the ages of ten and twenty years, European eels trek from the fresh waters of Europe to the Sargasso Sea to breed. This means swimming more than 6,000 kilometres on an empty stomach. The trek takes six months, and the fish live off their fat reserves.

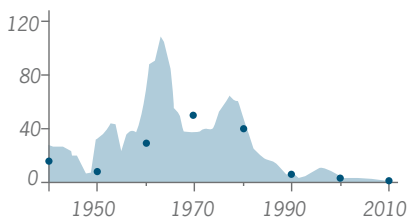


There is no hard evidence for the Sargasso Sea scenario: neither adult eels nor eggs have ever been spotted in the Sargasso Sea, only eel larvae, which could have been carried there on ocean currents. The eel larvae drift for one and a half years on the ocean currents in the direction of European coasts, where they develop into glass eels and swim upriver. There they grow into adult eels.



Eel stocks

Declining influx into IJsselmeer



- Number of eels per sample
- Running average (5 years)

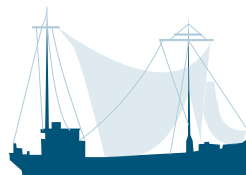
The influx of eels into the IJsselmeer in recent years has been a small percentage of the average between 1950 and 1980. This reflects a decline across Europe.

Threats

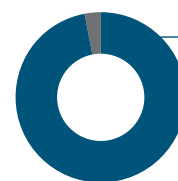
Fisheries in the Netherlands

Commercial catch
920 tons per year

Amateur catch
200 tons per year



Glass eel catch

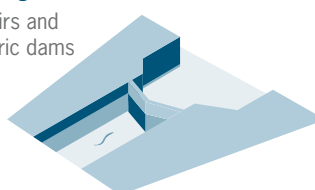


97%

Percentage of the total glass eel population. Glass eels are mainly bred for consumption.

Closed-off migration routes

Pumps, weirs and hydro-electric dams



Other threats

Diseases, water pollution, cormorants



MEASURES TO RESTORE EEL STOCKS

Europe

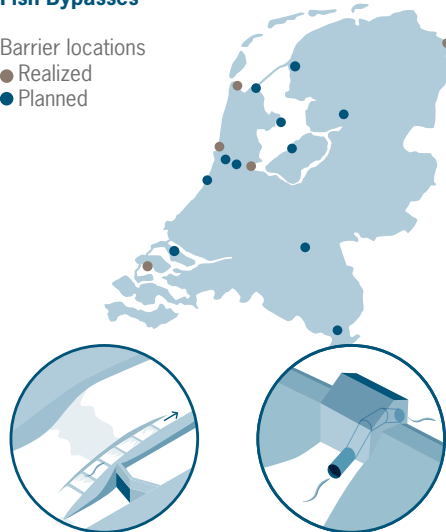
In 2007, the EU introduced legislation to protect the eel. Aim: 40% of silver eels reach the sea. EU countries each made their own eel management plan. In 2009, the eel was included in the CITES treaty on international trade in threatened species. Exports of glass eel from Europe have been banned since then.

Dutch eel management plan

1. Fishing ban from September to November
2. Removal or bypassing of 30 major migration barriers by 2027
3. Reducing eel deaths in three hydro-electric power plants on the major rivers by 35 percent
4. Releasing glass eels

Fish Bypasses

Barrier locations
 ● Realized
 ● Planned

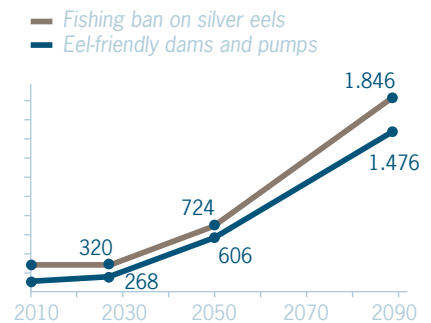


A fish staircase for getting past a dam or weir or bridging a difference in water levels

Special facilities to help eels get past power stations or pumps

Goals

The goal of efforts to restore eel stocks is an increase in numbers of out-migrating silver eels from the present 400 tons per year to 5,200 tons per year. Expected by 2090.



The effect of 2008 measures to improve eel stocks, expressed in tons of eels reaching the sea.

The idea of a total fishing ban in the Netherlands, such as the WWF proposes, does not go down well in all quarters. Van den Thillart and Verreth, and IMARES researchers De Graaf and Bierman, think it is necessary to restrict eel fishing but do not think an all-out ban would be sensible. They see the survival of the sector as important for monitoring eel stocks and as an economic incentive to maintain them. William Swinkels, board member at the Sustainable Eel Foundation (Dupan), a coalition of fishers, fish farmers and smokers, is even willing to have the costs of restoring eel stocks covered by the sector. 'Our right to exist stands or falls with the health of the eel stocks', he reckons. 'As a precaution you should allow the sector to continue as long as it helps restore the eel stocks.'

'You don't eat panda meat sandwiches and then donate the proceeds to panda conservation', says Drijver of the WWF, referring to a campaign in which Dutch MPs were offered bread rolls with a toy panda head sticking out of them to make a point about the implications of eel consumption. The WWF thinks eel fisheries have a bright future in spite of the current ban. 'We must not lose their knowledge' says Drijver. 'The fishers can play a role in the management of the inland waterways and the re-establishment of the eel.'

However, a fishing ban only works effectively if the migrating fish can reach the sea, and that is a major challenge, in view of the numerous waterworks in the Netherlands.

According to Marcel Klinge, fish migration expert at tech-

nical consultancy firm Witteveen+Bos, there are 10,000 weirs and almost 5,000 pumping stations on Dutch inland waterways. These barriers make it very difficult for glass eels to migrate up the rivers from the sea. But they are even more of a problem for adult eels on their way from the fresh water to the sea: the pumping stations then work like mincing machines if the eels risk swimming into them. 'Because eels are long fish, they do not stand much chance of getting through a pumping station alive', explains Klinge. According to Swinkels of Dupan, this is not the only problem. The pumping stations also make for an abrupt transition from fresh to salt water. Brackish water zones have therefore almost disappeared from most parts of the country. And these are precisely the zones in which the eel is at home. 'In areas where there are still some brackish zones, such as Zeeland, the eel is doing noticeably better', claims Swinkels, who says the eel habitat has shrunk over the years by 90 percent. He argues for a discussion that does not focus exclusively on the issue of overfishing. 'We want attention paid to improving the habitat and restoring migration routes.'

GETTING PAST THE PUMPS

The EU Framework Directive provides for such as approach, as it requires member states to take steps to open up their waterways for the fish so that they can get past the waterworks. The fish-friendly pumps developed by Klinge and his colleagues make this possible, but according to ex-

perts from Witteveen+Bos, things are moving too slowly. Between 2010 and 2015, the Netherlands needs to create 600 fish bypasses, but it is running behind schedule.

Action is especially slow in relation to the pumping stations. ‘The market needs time to accept innovations’, explains Klinge. ‘Which is particularly galling in this case because opting for fish-harming pumps now means the problem will still be with us for decades.’

A missed opportunity for the eel, because much can be gained by making the waterworks passable. According to the Dutch eel management plan, this measure would make a substantial contribution to increasing the numbers of silver eel that escape to the sea, so that it would reach about 1,500 tons in 2090. Together with a fishing ban, this would bring Dutch output to 3,500 tons in 2090. That is still not enough though. To keep the species going, researchers have calculated that it is necessary for about



‘Break down the Afsluitdijk, and you would do more to help restore eel stocks’

5,000 to 6,000 silver eels to reach the breeding grounds. ‘But we don’t know for sure whether 5,000 to 6,000 is the sustainable level; the calculations are shot through with assumptions’, says IMARES researcher Martin de Graaf. One thing is certain: the restoration of the eel is a long-haul project. One of the complicating factors is that eels live so long. Bierman: ‘Because these fish need ten to fifteen years before they can reproduce, the effect of measures can only be worked out much later.’ Eel stocks have not reached an all-time low yet, either, according to Bierman.

RESCUE PLAN

For the time being there are only plans and good intentions. Only the Sustainable Eel Foundation Dupan is already actively working on saving the eel. Since 2010, the foundation has released millions of young eels after feeding them up in nurseries to increase their chances of survival. The funding for this will be raised by selling eels for consumption. ‘One out of four young eels that come into the nursery will be returned to the wild’, says Swinkels proudly. Dupan has now received a grant from the Ministry of Economic Affairs, Agriculture and Innovation for research on whether the young eels that are released really do survive their return to the wild.

Scientists are cautiously critical of this kind of release. ‘Are these semi-tame eels really going to migrate to the breeding grounds?’ wonders Professor Verreth. ‘You are transplanting the eels, and whether that will really help to boost the population is not certain.’ Precisely because of the many uncertainties surrounding the eel, he feels it is important to tackle the issue with a wide range of measures. ‘Things are looking absolutely grim for the eel’, claims Johan Verreth. ‘In the short term it is impossible to come up with a rescue plan that guarantees success.’ For this reason, he feels the best hope lies in a combination of different measures. Restricting fishing, releasing young eels, and breeding them in captivity look like the most promising options.

BREEDING LARVAE

And in the field of breeding eels, there is even some light on the horizon. Up to now, no one has succeeded in getting the fish to breed in captivity, which made fish farmers 100 percent dependent on catching wild glass eels. But in eel research in Leiden, new insights gained into the energy use of swimming eels led to a breakthrough in knowledge about their reproduction. The group in which Tudorache and Van den Thillart work implanted modified cells from zebra fish embryos, which produce sex hormones, into adult eels. The fish then went on to produce sperm and embryo cells and eventually the team was successful in breeding larvae. Van den Thillart: ‘The principle is there now. We still need to do some fine tuning, but I think the method will be viable in five years.’ ■