**Swim-bladder nematode** (*Anguillicola crassus*)

<table>
<thead>
<tr>
<th>Common names in English</th>
<th>Swim-bladder nematode. Eel parasite.</th>
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<tbody>
<tr>
<td>... and in other languages</td>
<td>Danish: Svømmeblæreorm. German: Schwimmblasenwurm. Polish: Angwilikola. Swedish: Simblåsemask. Ålnematod.</td>
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<tr>
<td>Scientific name</td>
<td><em>Anguillicola crassus</em></td>
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<td>Organism group</td>
<td>Roundworms (Nematoda)</td>
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<tr>
<td>Size and appearance</td>
<td>The worms are brownish black in colour (as a result of their sucking blood from the wall of the eel’s swim bladder). The female grows to 5–7 cm in length and around 0.5 cm in diameter. The male is somewhat shorter, roughly 3–5 cm long.</td>
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<tr>
<td>May be confused with</td>
<td>Other <em>Anguillicola</em> species.</td>
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<tr>
<td>Geographical origin</td>
<td>South-East Asia, especially Japan (where it was discovered in eel farms in 1969).</td>
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<tr>
<td>First observed in Swedish waters</td>
<td>The species was first discovered in Sweden in 1987, in a Polish eel handled in this country, but was also recorded shortly afterwards in areas affected by cooling water from the Oskarshamn nuclear power station. As well as in the sea, it is now to be found in most Swedish lakes with eel populations, the first freshwater find here being in Lake Hjälmaren in 1992.</td>
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<td>Occurrence in Swedish seas and coastal areas</td>
<td>In the Baltic, from the Kattegat to the Archipelago Sea, and in the Skagerrak. <em>Anguillicola crassus</em> is also now to be found in areas of the Baltic not affected by cooling-water discharges. Infected eels are found off the west coast of Sweden, too, but in smaller numbers.</td>
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<td>Occurrence in other sea areas</td>
<td><em>Anguillicola crassus</em> probably occurs in most waters where eels are present. In Europe the parasite was first found in 1982, in Italian and German eel farms. It was subsequently observed in the Netherlands in 1985 and in Denmark in 1986, after which it spread throughout Europe. It was also discovered in the Baltic in the 1980s, and has now been recorded in all the countries around its shores. The species is to be found in sea areas (e.g. the North Sea waters of Britain, the Netherlands and Germany) and lakes throughout Europe; in the Czech Republic and Austria (Neusiedler See), in Turkey (Ceyhan River), and in the Caspian Sea. It has also spread to the United States and Africa (Lake Ichkeul in Tunisia).</td>
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Probable means of introduction
With infected eels imported into Europe from Asia (Japan).

Habitat(s) in which species occurs
The larvae of *Anguillicola crassus* pass through a first and second stage in the swim bladder of an eel. They then leave the swim bladder via its connection to the eel's pharynx and pass out of the fish through its intestinal tract.

Free-living larvae attach to various substrates in the aquatic environment, where they can survive for 1–2 months. They attach using their hooked tail and move their body vigorously to and fro, a behaviour that probably attracts copepods, which then feed on them. Once ingested by copepods, the larvae moult into the form that can infect eels. If copepods carrying larvae are subsequently eaten by a young eel, the larvae will be released into the eel's intestine and bore through the intestinal wall to reach the swim bladder. In the wall of the swim bladder, they develop into a new stage before entering the bladder itself.

Alternatively, copepods carrying larvae may be eaten by fish other than eels, and these then act as secondary intermediate hosts (paratenic hosts). The larvae migrate from the intestine of the fish to live in or around the swim bladder, but without harming their host. Several eel species other than the European eel *Anguilla anguilla*, as well as other fish species (e.g. ruffe *Gymnocephalus cernuus* and round goby *Neogobius melanostomus*), can become infested with larvae of this nematode, but without being affected themselves. Amphipods, ostracods, amphibians, insects, snails and certain birds can also act as paratenic hosts.

Larger eels feed on fish, and are therefore more likely to become infested via paratenic hosts than via copepods. If an eel ingests a host fish, the parasite will pass into the eel's swim bladder. Once there, it grows to sexual maturity within two to three weeks. The adult worms then mate, and a single female can produce large quantities of fertilized eggs.

*A. crassus* prefers warmed water, e.g. cooling water discharged from a nuclear power station, but there is concern that, by natural selection, it can gradually adapt to new environments, including the conditions found in Swedish waters. However, at water temperatures below about +10°C eels stop feeding, and for much of the year, therefore, there is probably no risk of their becoming infested in Nordic waters.

The larvae of this nematode have a far smaller chance of surviving at higher salinities. In fresh and brackish waters, free-living larvae can survive for weeks or even months, but in salt water they die within a much shorter time. What is more, no saltwater crustacean is known to act as an intermediate host. Once inside an eel’s swim bladder, however, the larvae can survive even if the eel enters highly saline waters. The swim-bladder nematode has been found in host fish in the open sea.

Ecological effects
*Anguillicola crassus* lives on blood from the dense bundle of capillaries (the rete mirabile) around the eel’s swim bladder. The eel consequently suffers anaemia, which is a stress factor for the fish and may impair its swimming ability. There is thus a greater risk of fewer eels reaching their spawning grounds in the Sargasso Sea (4,000–6,000 km away), which would pose a threat to the reproduction of the species. The swim-bladder nematode is also believed to reduce the eel’s natural resistance to changes in its environment. In Lake Balaton in Hungary, for instance, high mortality has been observed among infected eels as a result of a combination of stress factors: infestation
with the worms, combined with high temperatures and low oxygen levels in the water.

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<tr>
<th>Other effects</th>
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<tr>
<td><em>Anguillicola crassus</em> has caused major economic losses to eel farms. In recent years, catches of glass eels have fallen continuously, an effect that has been linked to the spread of this nematode in Europe. It is unclear what impact the parasite is having on Sweden’s wild eel population, but undoubtedly that population is still declining.</td>
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</tbody>
</table>

**FIND OUT MORE**


- North European and Baltic Network on Invasive Alien Species: *Anguillicola crassus*

- Baltic Sea Alien Species Database: *Anguillicola crassus*

- Alien species in Poland: Swimbladder nematode

- European Nature Information System Database (EUNIS): *Anguillicola crassus*
  [http://eunis.eea.eu.int/species-factsheet.jsp?idSpecies=42885&idSpeciesLink=42885](http://eunis.eea.eu.int/species-factsheet.jsp?idSpecies=42885&idSpeciesLink=42885)

- Leibniz-Institut für Gewässerökologie und Binnenfischerei: Immunology of *Anguillicola crassus*
  [http://www.igb-berlin.de/abt5/mitarbeiter/klauw 규정/ink/i_s.htm](http://www.igb-berlin.de/abt5/mitarbeiter/klauw 규정/ink/i_s.htm)

- Fishdisease.net: *Anguillicola crassus*

- Environment Agency. UK: Novel and category 2 parasites

- 3,4 MB: Nationaal Natuurhistorisch Museum: Non-indigenous marine and estuarine species in The Netherlands: *Anguillicola crassus*

- Dutch Society for Wildlife Health: International Trade in Live Fish: Risk of disease transmission between natural fish populations and aquaculture

- Joint Nature Conservation Committee: *Anguillicola crassus*
  [http://www.jncc.gov.uk/page-1684](http://www.jncc.gov.uk/page-1684)

- Gulf States Marine Fisheries Commission: *Anguillicola crassus* Fact Sheet

**PHOTO CREDIT**

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[http://www.abo.fi/instut/fisk/Swe/index.htm](http://www.abo.fi/instut/fisk/Swe/index.htm)

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