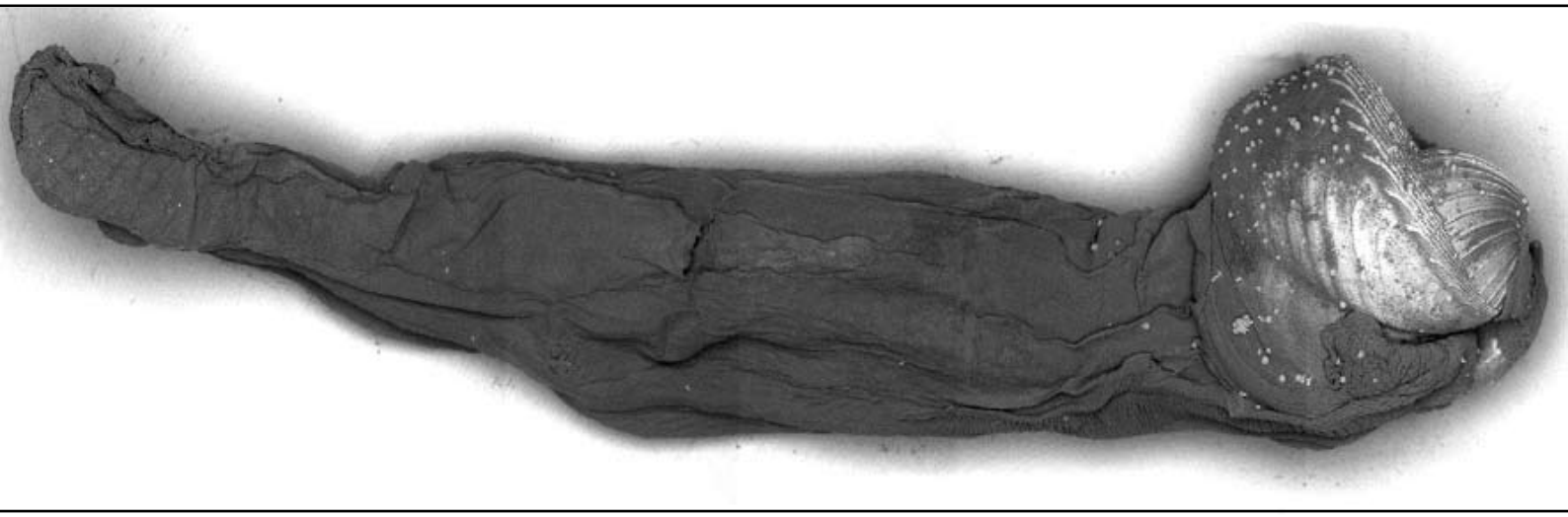
Shipworm (Teredo navalis)



Common names in English
Great shipworm. Naval (Atlantic, common) shipworm.

Danish: Pæleorm.
Finnish: Laivamato.
German: Pfahlwurm. Holzbohrmuschel. Bohrmuschel. Bohrwurm. Schiffs-bohrwurm.
Schiffsbohrmuschel.
Norwegian: Pelemark. Peleskjell.
Swedish: Skeppsmask.

Scientific name
Teredo navalis

Organism group
Molluscs. Bivalves.

Size and appearance
In a fully marine environment, the body of this species can grow to a length of up to 60 cm and a diameter of 1–2 cm. In the Baltic, it generally reaches about 20 cm in length, although it can be longer. The shell, on the other hand, is very small, with a length of at most 12 mm. A characteristic feature of boring bivalves is their greatly elongated, worm-like body, only a very small part of which is covered by a shell. The sole function of the short, gaping shell of the great shipworm is to act as a drill bit, boring circular burrows into wood. These burrows are lined with a calcareous deposit, secreted by the animal itself. To be able to drill efficiently, the animal has to be securely anchored. It presses certain parts of its body firmly against the walls of its burrow,

enabling the ridged shell valves to rasp away the wood. The softer the wood is (e.g. pine rather than oak), the more serious the infestation will be.

Teredo navalis attacks wooden structures as a pediveliger larva with a diameter of about 1 mm. It detects wood chemically from a distance and actively swims the last centimetre before it attaches itself to the surface with a byssus thread. The soft shelled larva penetrates the wood in an unkown manner, with maternal enzymes playing a role in softening the surface. The Teredo eats its way into the wood digesting it with the help of endosymbiotic bacteria. In this regard Teredo navalis is unique in this regard because it can survive on a wooden diet only, unlike other shipworms. However, it also filters and digests plankton from the seawater.

Undigested sawdust is expelled through the exhalant siphon, often accumulating around the siphons. The opening, which the siphons protrude through into the open seawater, can be closed with two paddle-like calcareous plates called "pal-

lets", which are important in identifying shipworm species. Sealed off the shipworm can survive for about three weeks, with the calcareous lining of the tunnel buffering the acid metabolites. Therefore it can withstand unfavourable conditions like exposure to air or fresh water. It even survives very cold winters, when the tunnelled wood is completely covered in ice. The larvae of T. navalis can live and settle in salinities as low as 9 psu, but the adults withstand even lower salinities. They grow to an average length of 20-30 cm., the largest specimen recorded in the Baltic was 59 cm.

Geographical origin
Pacific and Indian Oceans. May possibly be cosmopolitan in warm seas.

Occurrence in other sea areas
Various species of shipworms, including Teredo navalis, occur in seas and oceans worldwide.

Probable means of introduction
Teredo navalis was probably spread across the seas by wooden ships hundreds of years ago. It has been present in the North Sea for a long time.

Habitat(s) in which species occurs
The great shipworm lives inside wood – ships, jetties, piers and other structures that are constantly submerged in sea water. It lives at whatever depth its "home" (the wooden structure in question) happens to be, which may be anywhere from the water surface down to considerable depths. It reproduces best in warmer waters, but is also successful in colder seas. Living inside timber as it does, Teredo navalis is protected from predators.

Unlike other boring bivalves, T. navalis feeds almost exclusively on wood (sugar molecules in the cellulose). However, it also filters plankton from the water by means of a siphon, which protrudes through a hole in the wood and sucks in water (and with it oxygen and plankton).

Teredo navalis has been regarded as a marine species, requiring relatively high salinity, and up to now the Baltic Sea has therefore been considered safe from its attentions. However, there is documentary evidence of the species having occurred around Warnemünde on the Baltic coast of Germany as early as 1875. Along the westernmost stretches of that coast, it has reproduced periodically, in 2- to 3-year spells, over the last 50 years or so, but viable populations have never arisen. The great shipworm's failure to make serious inroads into the Baltic is the most important reason why large wooden ships have been found in such good condition after centuries on the seabed. Now, though, shipwrecks infested with the species have been found in the southern Baltic, from the entrance to the Baltic to Arkona on the island of Rügen. No one knows for sure what has changed to allow this shipworm to become established here: has the water become more saline, has the species modified its habitat requirements, or have shipworms from other sea areas hitched a ride into the Baltic in the ballast water of ships? It may be that the limiting factor for T. navalis is not in fact salinity, but water temperature, and if so even a small rise in temperature (and salinity) could open up the Baltic as a habitat for the species. German scientists have speculated that a combination of

warmer summers (resulting in warmer sea water), milder winters and higher nutrient inputs to the water (eutrophication) may have played a part in enabling the species to establish itself in the Baltic and begin to cause damage there.

Ecological effects

Shipworms are of major ecological significance, in that they breakdown organic material in the sea that has originated on land. This is particularly important in tropical regions with mangroves, where the large quantities of organic matter accumulating would otherwise take much longer to decompose.

Other effects

The great shipworm causes extensive and costly damage to unprotected and untreated timber structures. Wood that is attacked is damaged beyond repair by the many burrows bored into it. The hulls of wooden ships used to be protected with copper sheathing and, before that, with tar. There are reports that the species may have developed a resistance to anti-fouling agents such as creosote. Examples of damage and costs attributable to Teredo navalis:

From the Netherlands there were reports in 1731 of a "horrible plague" of shipworms that destroyed the dykes protecting the lowlands from the sea. According to the documents, the dykes collapsed, resulting in flooding.

Between 1919 and 1921 a succession of wharves, piers and ferry slips in San Francisco Bay collapsed following infestation with T. navalis (see "Additional information"). The destruction was extensive and costly. Varying figures have been put on the final bill, from $500–900 million, through $2–3 billion, to possibly as much as $20 billion, all at today's prices.

According to the German authorities, almost 10 million of damage was done to wooden structures along the coast of Mecklenburg-West Pomerania over a five-year period in the 1990s.

Additional information

The scientific name Teredo navalis comes from teredo = wood-gnawing worm (terebro = drill) and navalis = of ships or the sea. There are conflicting reports concerning the use of the common German name Schiffsbohrwurm ("ship-boring worm"). According to some sources, the name is used, not for T. navalis, but for the relatedspecies Psiloteredo megotara (previously known as Teredo megotara). However, Schiffsbohrwurm is frequently given as the common name for T. navalis.

On the Pacific coast of America, people already had bitter experience of the Pacific shipworm (Bankia setacea), a species requiring high salinity that had caused considerable damage along the coast. For this reason San Francisco Bay, with its brackish water, was chosen as the site for a new shipyard that would be "safe from attack by wind, wave, enemies, and marine worms". And then the Atlantic species Teredo navalis arrived. It was discovered in the Bay in 1913, and within a few years disaster had struck (see above).

Sources

Kai Hoppe, Teredo Navalis – The cryptogenic shipworm. (2002) In Invasive aquatic species of Europe. Distribution, impacts and management. Eds E. Leppäkoski, S. Gollasch and S. Olenin. Kluwer Academic Publishers, The Netherlands.

Great Shipworm

http://www.frammandearter.se/0/2english/pdf/Teredo_navalis.pdf

Figures

1) David Gregory
2 - 3) Christin Appelqvist