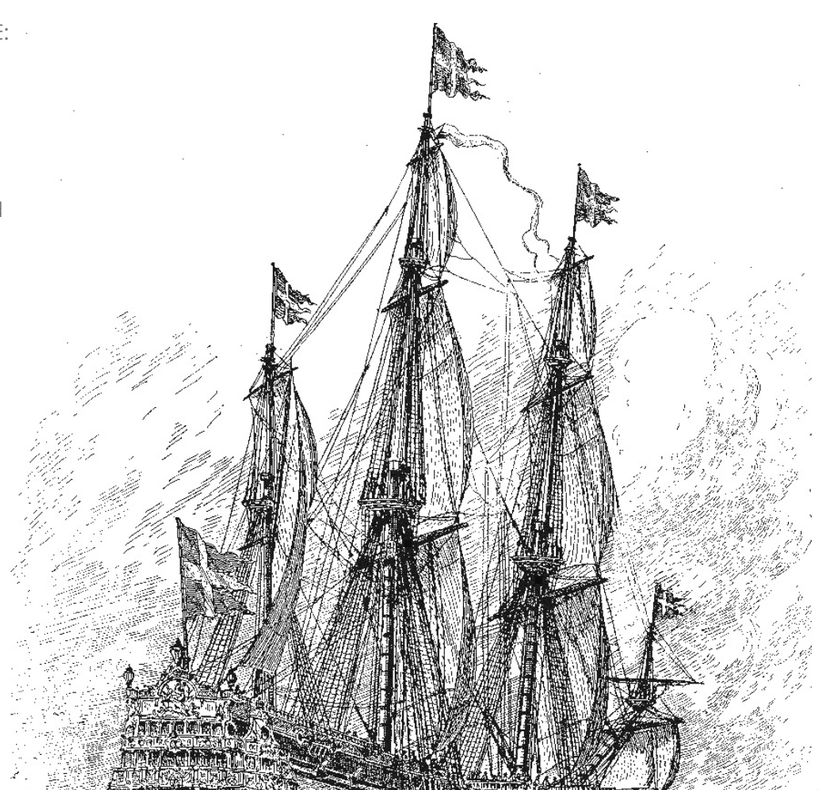
The Scourge of Wooden Wrecks

Shipworm

Is Really a Mussel

Text and photos
by Christian Skauge

PREVIOUS PAGE: Diver on a wooden wreck in the Baltic Sea; Shipworm holes bored into a piece of wood salvaged from the sea (inset)



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Historical illustration by Jacob Hägg (1839-1931) of the 17th century wooden Swedish ship of the line HMS *Stora Kronan*

Shipworm holes (above and right) in a salvaged piece of wood. The *Teredo navalis* species of shipworm usually grows up to 30cm long, but has been known to reach up to 60cm in length and 1-2cm in diameter.

Have you ever wondered why some bodies of water, such as the Baltic, have so many wooden wrecks in great condition while other areas have almost no wooden wrecks at all? It has something to do with salinity; however, it is not the salt in seawater that consumes the wrecks but a mussel, which somewhat confusingly is called a worm—and it only lives in saltwater.

In fact, shipworms are not worms at all, but rather a group of unusual saltwater clams with long, soft, naked bodies. Sometimes called "termites of the sea," or pileworm, the shipworm is a group of approximately 65 species of marine bivalve mollusks, which are responsible and notorious for boring into and eventually destroying wood that is immersed in seawater—and not just wrecks but also piers, dykes, bulwarks and other submerged wooden structures. Even today, when most ship hulls are made of steel and leisure boats of glass fiber, these mollusks continue to be a major cause of damage to infrastructure worth billions.

During the Age of Sail (from the mid-16th to the mid-19th century), ships' wooden hulls were under continuous attack by shipworm, which posed a significant problem for shipping. Many different methods were tried in order to protect ships against being eaten by shipworm, and in the late 1750s, the British Royal Navy conducted the first experiments with copper sheathing in which copper plates were affixed to the outside of the hull. The copper performed very well, both in protecting the hull from worm invasion and in preventing weed growth.

The best known species, *Teredo navalis*, is found in both temperate and tropical seas and oceans worldwide. It may have originated in the northeast Atlantic Ocean, but it is difficult to establish where it originally came from because it has spread so efficiently around the world on debris and the hulls of ships.

The shipworm's body is cylindrical, slender, naked and superficially vermiform, meaning "worm-shaped." It lives in a burrow (in wood or clay), which it rasps out with its small trilobed shells and lines with a calcareous secretion. When shipworms bore into submerged wood, they digest the exposed cellulose in the fine particles created by the excavation in a special organ called the gland of Deshayes.

Up to 60cm long

Shipworms have a pelagic larval stage when they drift freely in the water before they attach to wood and undergo a metamorphosis. In the beginning, the shipworm is small and only makes millimeter-sized holes in the wood,

Shipworms dig burrows into wood and line them with a thin layer of lime, which remains even after the animals die.

but when it grows, the burrows can become several centimeters wide. *Teredo navalis* normally grows up to 30cm long, but specimens of a full 60cm in length and 1 to 2cm in diameter have been observed in Danish waters. The lifespan of a shipworm is two to three years, and it lives all its adult life inside wood at depths where it is available. It can therefore be found from the surface down to significant depths.

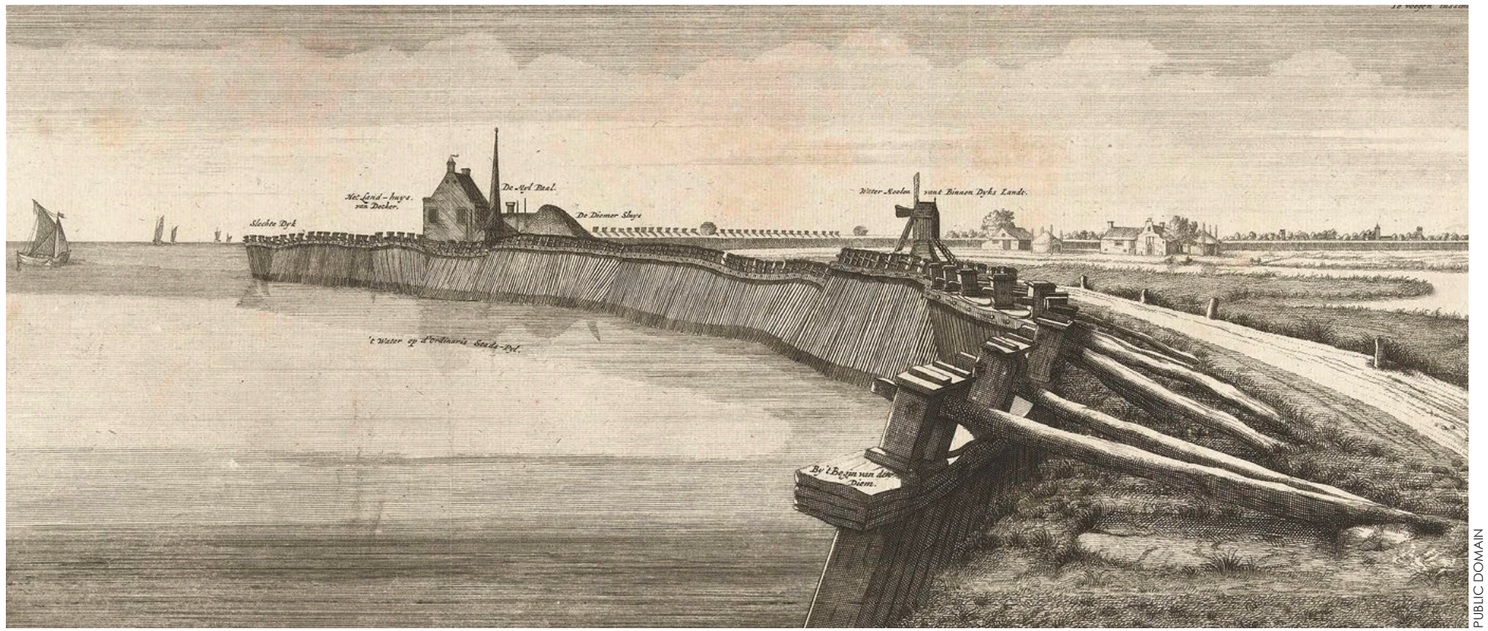
The inside of the burrows it digs in the wood is clad with a thin lime layer, and this remains even after the animal itself is dead. The lime layer provides protection against the environment, just like a shell, and the passage is sealed at the end with a plug called the septum. In the plug, there is a small hole where the shell's breath or siphon can be inserted to breathe in freshwater. The siphons can be quickly withdrawn in case of danger, and are protected under a pair of 0.5cm long, lime-like tentacles.

Clever adaptation

Shipworms can survive in water temperatures of up to 30°C, but grow little if in waters warmer than 25°C. It can live in waters with a salinity of 5 to 45ppm (parts per million), but thrives best waters with normal salinity of 33 to 37ppm. A salinity of less than 5ppm is lethal to the larvae, and if salinity drops below 20ppm, the shipworm does poorly. Wrecks that are found in sea areas with these conditions are therefore usually left in peace. At the bottom of the Baltic Sea in the Gulf of Bothnia and the Gulf of Finland, there is a salt content of only 2 to 7ppm, and the wrecks found there are often incredibly

Shipworms include around 65 species of marine bivalve mollusks, of which *Teredo navalis* is the best known.

wreck rap



Historical illustration from 1705 of a wooden dike in the Netherlands. Shipworm attacked the wooden dikes in the 18th century causing massive damage, threatening to flood large parts of the country. This led to the replacement of all wooden dikes with stone dikes along the entire North Sea coast; A specimen of shipworm (left)

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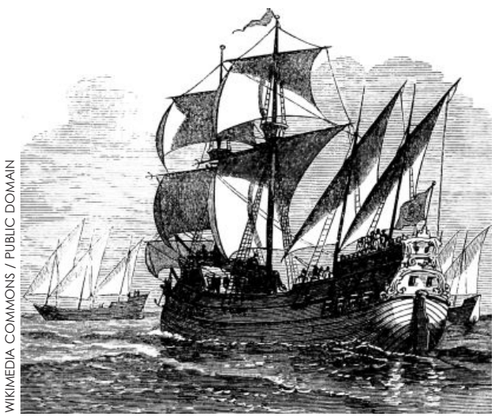
The termite of the sea

The shipworm is often called the "termite of the sea" and is notorious for digging times in piers, wooden boats and other wooden structures in the water. Thanks to a symbiosis with special bacteria, the shipworm is able to digest cellulose, and thus it can feed on wood.

Shipworm is perhaps the worst invasive species of all time and is responsible for enormous destruction. In the 1800s, wooden ships could be eaten to pieces in as short a time as eight years, and the shipworm was a serious limiting factor for shipping. Many different methods were used to defend against the attacks, and one of the most common was to dress the hull with copper plates on the outside. The ships of Christopher Columbus were among the first to use this protection.

Shipworm can survive for periods of up to six weeks without oxygen, by not eating and living on stored glucose in the body. This allows it to survive within the wood of a ship visiting waters that would normally not provide good survival conditions for the shipworm.



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Historical illustration from 1880 of Christopher Columbus' ships: the *Niña*, the *Pinta*, and the largest, the *Santa Maria*, in the foreground

Enormous destruction

When the shipworm was introduced to the western coast of the United States by visiting sailing ships in 1913, it led to a serious invasion, which in 1919 to 1921 destroyed an unknown number of wharfs, piers, docks and other wooden structures in the port of San Francisco. Calculations estimated the damage to be somewhere between US$2 and US$20 billion in today's currency.

As recently as 1946, damage by shipworm on ships and port facilities in the United States alone was estimated at US$55 million a year.

Most devastating was perhaps the massive attack on the Dutch dikes of the 18th century. The ravages of shipworm threatened to break down the dikes and put large parts of the Netherlands under water. A commission called the shipworms a "terrible plague," which led to the wooden dikes being replaced with dikes of stone along the entire North Sea coast.

For divers who love diving on wrecks, the shipworm is an "enemy," which eats up cherished wooden shipwrecks. But the shipworm also has an important ecological function in tropical areas that have a lot of mangroves. Here, it helps to break down large amounts of organic matter faster. However, in the Western world, the shipworm is first seen as a pest.

Cosmopolitan

The shipworm has been transported by ship around the world for so many hundreds of years that the original site of its propagation is no longer known. Some believe it originally came from Europe, but there is also a theory that it originated in Southeast Asia.

In the Philippines, the shipworm is called *tamilok*, and is considered a delicacy. They eat it raw with vinegar or lime juice, chopped chili and onion. The taste has been compared to everything from milk to oysters. The use of it as food in this region supports the theory that it has its origin here, but the fact that it thrives best in water colder than 25°C points to Europe as its origin.

Regardless of where the shipworm originally comes from, it is reasonable to say that it has been introduced to both coasts of the North American continent, and the first shipworm was reported on a visiting wooden ship in Massachusetts in 1839. Within a hundred hundred years, the species was common all the way from Nova Scotia to the Caribbean. Nowadays, shipworm is widespread in both tropical and temperate waters around the world.

J. LINDSTRÖM / STATENS MARITIMA MUSEER / CC BY 3.0

Wooden planks of the Dalarö wreck site in Sweden are still intact.

In Norway in the 18th century

In my home country of Norway, the shipworm must have been observed for the first time in the 1700s, while it first came to Kattegat (an area of sea between Denmark and Sweden) in the 1800s. It was first described by the

Swedish botanist and zoologist Carl von Linné in 1758. Today, the species is listed on the Norwegian blacklist of alien and unwanted species in Norwegian waters.

None in the Baltic Sea

Thanks to the low salinity in the central and northern parts of the Baltic Sea, this sea area provides the best conditions for the preservation of the wooden wrecks, because the shipworm is not found here. Finds like the *Vasa*, *Kronan* and Dalarö wrecks and several other well-preserved ships from the 16th and 17th century show clear evidence of this. In fact, despite many efforts, humans have not yet come up with a better method of preserving wood than hiding it in the Baltic Sea and letting nature take its course.

In the open waters of the Baltic Sea, the salinity is also low, at 10 to 16ppm. In the outflow of Øresund (the strait between Denmark and Sweden), the salinity rises to 20 to 23ppm, and here the shipworm has recently established itself, as we will see later.

Despite the fact that shipworm has traditionally not thrived in the Baltic Sea, since 2000, more and more discoveries have been made of infested timber in the southern parts of the sea. Since earlier times, it has been known that the shipworm has multiplied every two to three years along the German Baltic Sea coast, but now it has been reported that over a hundred wooden wrecks are infected by shipworm from the inlet of the Baltic Sea and east to the island of Rügen.

Salinity or temperature?

It is not known what has caused the shipworm to have established itself in this area, and both changes in salinity and the shipworm's adaptability have been mentioned as possible factors. Other theories propose that the shipworm may have come with the ballast water in ships, or is introduced through Øresund with saltwater in connection with storms. It is also speculated that it may not actually be the salinity that is the determining factor for shipworm propagation, but rather, it is temperature.

It is known that shipworms do not thrive in waters that are too cold, an example of which includes the northern parts of the Norwegian coast. In Finnmark, which is located in Arctic waters, the shipworm is rare or not present at all.

German scientists are now investigating whether a combination of warmer summers with higher sea temperatures, milder winters, and a greater supply of nutrients from agricultural runoff may have led to the shipworm being able to establish itself in the southern area of the Baltic Sea.

Global warming threat?

If the German researchers are right in their assumptions, this means that only a slight increase in temperature (and hence the salinity, due to greater evaporation) will give the shipworm better opportunities to survive. The environment in the Baltic Sea can thus be severely threatened with global warming, and many marine archaeologists (and divers) fear that the shipworm in time will invade the whole of the Baltic Sea and destroy the many amazing treasures found here. ■

Christian Skauge is an award-winning underwater photographer based in Oslo, Norway, and is the owner and editor of the Norwegian dive magazine, Dykking. He is particularly interested in photographing macro life, but also enjoys wide-angle wreck photography. For more information, please visit: ***Scubapixel.com****.*

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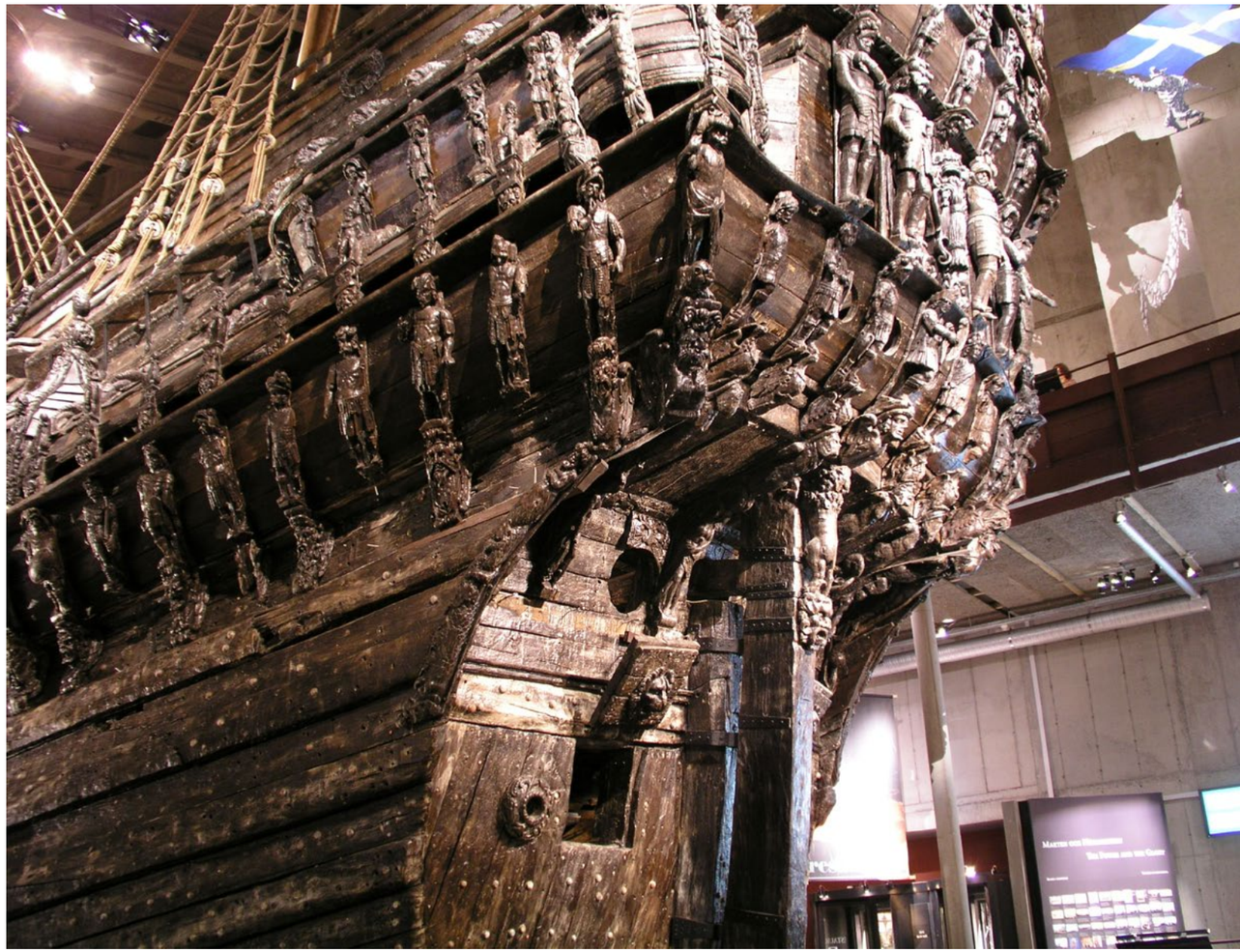

THIS PAGE: *Vasa* is a wooden Swedish warship built between 1626 and 1628, housed in the Vasa Museum in Stockholm.