United States Department of the Interior
Fish and Wildlife Service
- - - - - - - - -
Fishery Leaflet 3
superseded by FL 505
Washington, D. C. May, 1945

SHIPWORMS AND OTHER MARINE BORERS

By Paul S. Galtsoff, Biologist,
In Charge of Shellfish Investigations
Division of Fishery Biology

SHIPWORMS

Classification and distribution.-- The shipworm is a mollusk belonging to the class Pelecypoda, which includes those forms that have bivalve shells, such as oysters, clams, and mussels. In appearance the shipworm differs greatly from the more familiar mollusks of the same class because the two valves of the shell are reduced to a pair of small plates at one end of a long, wormlike body. Formerly most infestations of shipworms were believed to be caused by one species, Teredo navalis, a member of the family Teredinidae. Although Teredo navalis is quite widely distributed, it is now known that there are a great many additional species of shipworms that occur in different parts of the world. Each species has its definite geographical range.

Description.-- The general appearance of the shipworm, and its superficial resemblance to the common worms, caused early students to be misled and fail to recognize it as a mollusk. Fundamentally the shipworm is built along the same lines as a typical mollusk, but parts of its body have become modified to adapt it to its peculiar mode of life. The two valves of the shell no longer encase and protect the soft parts of the body, but appear only at the anterior end of the animal where they serve as tools for boring into wood. The body has become greatly elongated, and in some species may reach a length of 3 to 4 feet and have a diameter of less than 1 inch. The edges of the valves are equipped with rows of fine, sharp-pointed teeth which resemble the projections on a coarse wood file when viewed with the aid of a microscope. By moving the valves in a rocking or twisting motion the young shipworm is able to excavate with a fair degree of speed. The long, soft body, which fills the burrow completely, is protected from injury by a calcareous coating which is secreted and laid down on the walls of the burrow. The calcareous secretion comes from the mantle, an external layer of tissue possessed by the shipworm, and which is common to all other mollusks.

At the posterior end of the body are located two tube-like structures which are open at the ends. One of these is called the incurrent siphon, and the other the excurrent siphon. When the animal is extended normally the ends of the siphons project through the opening of the burrow and into the water. By the continuous vibration of the millions of cilia within the canal that passes through the body, a current of water flows in through the incurrent siphon and out through the excurrent siphon.

The entering water carries minute free-swimming organisms, known as plankton, that are used for food. The plankton animals and plants are strained from the water by means of the gills and pass into the gullet. The current of water passing through the body also sweeps into the digestive tract a good deal of fine "sawdust" produced by the rasping of the wood. It was long debated whether the shipworm fed on this material or whether it depended for its nourishment on the plankton organisms taken in through the siphon. It is now known that the animal is able to digest and utilize a large proportion of the cellulose in the wood. Dissolved oxygen in the water is taken up by the blood through the gills and the current of water also keeps the body moist. Waste materials are discharged through the excurrent siphon.

The "pallet" is an organ peculiar to the shipworm. This is a hard, calcareous structure which varies in shape according to different species of shipworms, and servesto plug the mouth of the burrow. If for any reason conditions outside the burrow become unfavorable, the siphons are drawn into the burrow and the pallet, composed of two parts, is extended across the opening. Enough water is retained within the burrow to keep the body moist until the siphons are extended once more and the normal current of water through the body becomes reestablished.

Reproduction.-- Some species of shipworms are hermaphroditic, that is, may produce both sperm and eggs, although not at the same time. Other species are of separate sexes. The eggs and sperm usually are discharged through the excurrent siphon and fertilization takes place while the eggs and sperm float freely in the sea. In some species, however, including the common Teredo navalis, the eggs remain in the gill chamber of the female and are fertilized by the sperm from another animal which is drawn in with the entering current of water.

Development.-- The true position of the shipworm in the animal kingdom is demonstrated by the larva, which is similar in appearance to a typical bivalve mollusk. Soon after hatching the larva develops a bivalve shell which pivots on its hinges, and into which the entire body may be withdrawn. It has a comparatively large muscular foot which enables it to crawl over surfaces of submerged objects. It also has a velum, or paddle-like swimming organ by means of which it is enabled to lead a free-swimming existence. When the larva is ready to transform it crawls over a surface of a submerged pile or other wooden structure until it finds a suitable notch or crevice. It then secretes a byssus thread by means of which it is attached to the surface of the wood, and its sedantary life begins. The shell transforms into the rasping organ previously described. The foot is changed to a pestle-shaped organ which assists the boring shell with its excavation, and the velum is absorbed. The young shipworm bores into the wood, and as the burrow grows deeper the body elongates so that it always fills the burrow. External contact with the sea is constantly maintained by means of the extended siphons.

Damage by Shipworms.--The damage to submerged wooden structures caused by shipworms is enormous. They enter the wood as minute individuals and hence the entrance hole is very small. The external opening never changes materially in size, so that a piece of timber may be thoroughly honey-combed with shipworm burrows and yet reveal but little

external evidence of the fact. Since their presence may not be easily detected until the structure collapses, heavy infestations of shipworms are treacherous and costly.

MARINE BORERS

There are other organisms, belonging to different groups of animals, that bore into and cause damage to submerged structures. They may be designated collectively as "marine borers" and the principal types are the following:

Crustacea.-- Members of three genera of crustaceans embrace species which are important wood borers, namely, Limnoria, Sphaeroma, and Chelura. Limnoria lignerum is the most important of these pests. It is widely distributed and frequently very destructive, and is especially dangerous because it appears to be able to attack creosoted timber to a much greater extent than other boring organisms. Instead of boring deeply into the wood the crustacean borers excavate "galleries" immediately beneath the surface and hence the results are not as dangerous as the burrowing of shipworms. When the underlying layer becomes honey-combed the surface layer of wood frequently is washed away, thus exposing the work of the crustacean borer and giving ample warning of the need for repairing the damage.

Martesia, the boring clam.--This bivalve mollusk belongs to the family Pholadidae. It is closely related to the shipworms but the body is not worm-like and the animal is capable of withdrawing entirely into it s shell. The burrows are not very deep, but sometimes cause considerable damage. The boring clam is not nearly as common as shipworms.

Rock Borers.-- There are a number of marine organisms that are capable of burrowing into rock and sometimes cause injury to submerged concrete or stone structures. The more important of these animals are various species of mollusks belonging to the genera Pholadidea, Petricola, Platyodon, Saxicava, Carditramera, Lithophaga and others. Some species of sponges, worms, and crustaceans also are rock borers. The damage caused by these animals seldom is more than superficial, and deep penetration resulting in collapse of the stone or concrete structure is not likely to occur.

PROTECTION OF SUBMERGED WOODEN STRUCTURES

The protection of submerged structures against shipworms and other marine borers is essentially an engineering and chemical problem. In general submerged wooden materials can be protected by:(a) impregnating the wood with some toxic substance which is repellant to the boring organisms, or(b) covering the surface with metal sheathing, concrete, or an anti-fouling paint. Creosote is best for impregnation, and although it gradually leaches out of the timbers and does not give absolute protection, the life of the wooden structures can be prolonged many years by its use. The effectiveness of creosote treatment depends upon the kind of wood, the method of impregnation, the composition of the creosoting material, the locality, and the climate. Metal sheathing is effective but must be frequently replaced because of the corrosive action of sea water on the materials. Concrete sheathing likewise is affected by sea water, and is less satisfactory than creosote. Recently the Navy has announced the development of two anti-fouling paints, which prevent the borers from

gaining initial access to the wood: 16A, a paint containing cuprous oxide, and AF23, a metallic copper paint. A reported observation that dynamite charges detonated in the water are effective in killing shipworms has not yet been verified experimentally.

REFERENCES

ATWOOD, WILLIAM G., AND JOHNSON, A.S.
1924. Marine structures, their deterioration and preservation. Report of the Committee on Marine Piling Investigations. National Research Council, 534 pp., illus. Washington, D. C.
(A monographic account of the subject from the standpoints of physics, chemistry, biology, and engineering; contains an extensive bibliography.)

BARTSCH, PAUL
1922. A monograph of the American shipworms. Bull., U.S.National Museum, 122, 51 pp., illus.

PURCHON, R. DENISON
1941. On the biology and relationship of the lamellibranch Xylophaga dorsalis (Turton). Jour., Mar. Biol. Ass. U.K., 25 (1) : 1-39.

SIGERFOOS, CHARLES P.
1908. Natural history, organization and late development of the Teredinidae, or shipworms. Bull., U. S. Bur. Fish., 27: 191-231, pls. 7-21. (Out of print.)

VISSCHER, J. PAUL
1929. Nature and extent of fouling of ships' bottoms. Bull., U.S. Bur. Fish, 43 (pt. 2): 193-252, 40 figs. (Out of print.)