Lernaea cyprinacea

Information Classification

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By Henna Tirmizi

Kingdom: Animalia
Phylum: Arthropoda
Class: Maxillopoda
Order: Cyclopoida
Family: Lernaeidae
Genus: Lernaea
Species: **Lernaea cyprinacea**

Geographic Range

Lernaea cyprinacea has been recorded in many places around the world. It has been found in parts of Europe, such as Scandinavia, France, Italy, and Germany, all the way to Japan. The parasite is spread throughout Central Asia as well as in the southern regions of West Siberia. The spread of *Lernaea cyprinacea* northward is limited by temperature. It is an exceptionally thermophilic organism of southern origin, and it develops successfully only at high temperatures. Temperatures between 23-30°C are the most favorable for development. (Baur, 1962)

Biogeographic Regions: indian ocean (native); atlantic ocean (native); pacific ocean (native).

Habitat

These parasites live in freshwater habitats. The salinity of the water affects how well the copepod reproduces. "Sweet water" is the only possible environment for the *Lernaea cyprinacea* reproduction to be possible. This parasite was found in ponds with 0.071-1.6965% NaCl. All of the copepods were found in fresh-water and flood lakes only, never in saltier neighboring lakes.

Since the host specificity is so low in this parasite, there is a large range of host species. In Russia, there are reports of mass infection of the crucian carp (*Carcassius carassius*). The mosquito fish that were released in Central Asia for the control of malarial mosquitoes are parasitized greatly. The copepod is also found in North America. Local American fish such as *Lepomis* spp. and *Ictalurus* spp. possess the parasite in small numbers. These parasites have been found on hosts other than fish. Sexually mature females have been found on a *Rana ridibunda* tadpole as well as on a *Diemyctelus pyrrhogaster* salamander. (Baur, 1962; Hoffman, 1967)

These animals are found in the following types of habitat: temperate; tropical; freshwater.

Aquatic Biomes: lakes and ponds; rivers and streams; temporary pools.

Physical Description

Lernaea cyprinacea goes through many metamorphoses throughout its lifetime. With each stage, the copepod gains, loses, or modifies the structures on its body. The nauplius stage that hatches from the egg looks very different from the adult. Not only do the young vary in morphology from the mature adults, but sexual dimorphism marked as well. The male is dwarfed and attached to the much larger female.

The mature female is about 9 mm in length on average. Her cephalothorax has four horns, which vary slightly in length. The horns are conical and soft. The anterior ventral pair is simple, while the dorsal pair is T-shaped. The head of the copepod is a small bump that projects between the horns. The female has a slim, cylindrical neck that gradually enlarges into a larger trunk. Its abdomen is short and rounded at the end and has three segments. The mouth-tube is absent in the adult female. The structure of the mouthparts themselves is not understood very well. A small projection, believed to be the upper lip, covers part of the mouth. A large, completely separated, lower lip closes the oral space behind the maxillae. The mandibles are very small. They are partially covered by upper lip as well as by maxillule. These simple curved stylets, with an enlarged base, can only be seen with difficulty. The Maxillipeds are located behind the mouth. They are distinctly segmented. Segment one has an inner papilla that contains a small seta, while segment two has five strong claws. The first maxilla is nodular and is tipped with a small chitinous projection. The second maxilla terminates into two stout claws.

The first four legs of *Lernaea cyprinacea* are very small. They are biramous and each branch has three segments. Its first leg is located just behind the arms and the second through fourth legs are widely spaced along the body. The egg sacs that the adult female produces are long and slender. The eggs are multiseriate and the shape varies, depending on the age of the eggs. They can vary from elongated and conical to oval shaped.

The free-swimming, juvenile female is much smaller than the adult. It has an average length of .7 mm. In the nauplius stages the *Lernaea cyprinacea* has a transparent or light green color. In its copepodid stages it has the normal body form as other copepods. Its abdomen has four or five somites. The first and second somites are completely separated. The female's cephalothorax contains a transverse chitinous bar that divides it into anterior and posterior regions. Its furcal rami have dorsal and lateral setae as well as three apical setae. The distal half of the middle setae is long and feathered. The appendages and mouthparts of the free-swimming female are the same as in the mature form, except the antennule has a 5th segment separated.

The male differs greatly from the adult female, but shares similar morphology to that of the free-swimming female. It is not obviously apparent, but the antennule is segmented into six segments. Its first leg has a larger claw and a smaller inner spine. The antenna of the male is shorter than in the female, it has a larger claw as well. (Calman, 1911; Gurney, 1933; Yamaguti, 1963)

Some key physical features: ectothermic; heterothermic; bilateral symmetry.

Sexual dimorphism: female larger.

Development

Lernaea cyprinacea eggs hatch in 1-3 days. When they hatch they are in the nauplius stage. This is a six-legged elliptical larva. There are three nauplius stages. The first is the oval form, next is the without mouth or labrum form, and the third is a form with a single pair of furcal setae. After 4 to 16 days in the nauplius stage it metamorphoses into the first copepodid stage. After this metamorphosis, no further development occurs unless a host is found. The parasite then attaches to the host and undergoes further transformation. After attaching to the host, the larvae are not able to swim anymore because their appendages are reduced to short stumps and their setae are lost. The larvae spends some time on the host. They then molt. With this process they reform thier apendages and acquire the ability to swim again and leave their intermediate host. The larva passes through 5 successive copepodid stages before the female attaches. In the fourth copepodid stage, both sexes become sexually mature. In this free-swimming stage the female becomes fertilized and the male dies without developing further. The females seek their second host. This is where the females form their egg sacs. About 14-28 days are needed to go from hatching to the production of egg sacks, depending on the temperature. In cold temperatures it could take up to a year to produce a new generation. Under natural conditions, however, several generations occur in the course of one year. Throughout its development certain parts of the parasite grow, while other parts are inhibited or even reduced in development. While the organism is in its free-swimming stages

of life, its legs are well developed to aid with swimming. In the organism's parasitic stages it is on a host, and does not need these appendages. (Calman, 1911; Gurney, 1933; Hoffman, 1967; Yamaguti, 1963)

metamorphosis.

Reproduction

In the fourth copepodid stage, both sexes become sexually mature. In this free-swimming stage the female becomes fertilized and the male dies without developing further. The females seek their second host. This is where the females form their egg sacs.

Key reproductive features: gonochoric/gonochoristic/dioecious (sexes separate); sexual; fertilization (internal); oviparous.

Behavior

These parasites attach to the gills of fish, using their frontal cement gland. The copepod usually lives on the surface of the body. After eating away the scale of the fish, it enters the internal tissues. This causes the fish to undergo significant changes in its structure and tissues. The fish reacts by trying to isolate the parasite and form a compact sheath. This sheath is made up of a thick layer of epithelial and connective tissues. The formation of this sheath causes the tissues of the fish to swell. These swollen tissues often become stained red with the increased activity of the parasite. In mosquito fish, the copepod destroys the host's fins. This is especially disastrous to the host when infection of the male's sexual fin causes paralysis and thus sterility. Although the parasites are found on the fish any time of the year, high infestation intensity which leads to death of the fish occurs only in the summer. The differences between the sexes are apparent when the female is observed fixed immovably to her host, while the much smaller male lives on the female's body. The male uses its prehensile second antennae to hold on as well as crawl around the body of the female. (Baur, 1962; Yamaguti, 1963)

Key behaviors: parasite; motile; sedentary.

Communication and Perception

Crustaceans have various sensory resceptors, mainly setae over the body. Photoreceptors are also generally present. (Brusca and Brusca, 2003)

Communicates with: visual; tactile; chemical.

Perception channels: tactile; chemical.

Food Habits

Many kinds of fish are the intermediate and definitive hosts. Mainly these hosts are from the family Cyprinidae. Fish such as *Carissus auratus*, *Anguilla japonica*, *Carassius vulgaris*, *Gobio fluviatilis* and *Cypinus carpio* all are parasitized by *Lernaea cyprinacea*. Many fish serve as intermediate as well as definitive hosts during heavy infestation. The parasite feeds on the internal tissues of the fish. It attaches to the gill chambers of the fish and parasitizes it externally. This parasite is a big threat because it lacks host specificity to such an extent that it can infect all freshwater fish and even frog tadpoles and salamanders. (Baur, 1962; Hoffman, 1967)

Primary Diet: carnivore (eats body fluids).

Animal Foods: body fluids.

Predation

These species are probably preyed on indirectly. Several of the larval stages die due to not reaching a suitable host.

Ecosystem Roles

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Key ways these animals impact their ecosystem: parasite.

Species (or larger taxonomic groups) used as hosts by this species

- *Anguilla japonica*
- *Carissus auratus*
- *Carassius vulgaris*
- *Gobio fluviatilis*
- *Cypinus carpio*
- Cyprinidae

Economic Importance for Humans: Negative

Lernaea cyprinacea can obviously become a problem for fish farmers. The parasite not only causes disfigurment in the fish, but it can also cause its death in cases of high infestation. The farmers are unable to sell these sick fish, and lose a great amount of money. In Japan, the parasite has increased its number and spread to such an extent that it is a serious menace to fishing culture. It was first found to be causing damage to eels, in this case choking the mouth cavity, but it is also found on other fish, burrowing with the head under the scales. Countless pounds of fish have been destroyed because of this parasite. (Baur, 1962)

Ways that these animals might be a problem for humans: causes or carries domestic animal disease.

Other Comments

One method for destroying parasite is treatment with a solution of bleaching powder containing .0001% chlorine. A concentration of .0005% is much higher. This concentration kills fish, but not the adult parasite, so that effective attack can only be made on larvae during spring. By this method, some control has been established (Gurney 1933).

Contributors

Henna Tirmizi (author), University of Michigan: January, 2003.
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