

□ CLASS ACANTHOCEPHALA (Thorny-headed)

- Acanthocephalans are parasites that live in the intestines of many fish species world wide (**salmon, trout, carp**). The adult worms are found in the intestine and sometimes in **the stomach or pylorus**. Acanthocephalans, also known as '**thorny headed**' or '**spiny headed**' worms
- They vary in length from **1 mm to 50 mm** in fish. Bodies **cylindrical or flattened** with anterior end bearing hooked proboscis (spiny-headed worms- **anterior end is bearing hooked**). They have a proboscis and anchors themselves in the intestinal wall of their host. Acanthocephalans are **dioecious** and often **sexually dimorphic**, with the females growing larger than the males.
- Genera commonly found in fishes are **Acanthocephalus, Neoechinorhynchus, Echinorhynchus** and **Pomphorynchus**. The shape of the proboscis, the arrangement and the number of proboscis hooks are important characteristics used to definitively identify.

- The life cycle is complex, and includes **arthropod** as an **intermediate host** and a **vertebrate definitive or paratenic host**.
- Spindle-shaped eggs are released from the female worms into the intestine of the **fish final host** and are discharged with feces into the environment. After ingestion by an appropriate **intermediate host (crustacea, amphipod-gammarus, ostracod, copepod, isopod)**, the egg hatches to liberate the **acanthor** larva, which moves out of the intestinal lumen into the host hemocoel there developing into the **acanthella**.
- When development of the acanthella is completed, it becomes a resting infective stage, called the **cystacanth** that remains dormant until its host is eaten by the appropriate **final host (salmon, trout, carp)**. When a suitable final host ingests the infective stage, the parasite is activated and an immature worm becomes established in the intestine.

- Worms bore their proboscis into the intestinal wall and feed on the digested food. Similar to the cestodes, the acanthocephalans absorb nutrients directly from the intestine of their host and lack both mouth and digestive tract.
- They attach by embedding a spiny organ, the proboscis, into the tissue, where they cause local damage. Total loss/degeneration of the intestinal villi and formation of granular tissues and capsule formation affect the digestive and absorptive efficiency of the animal.
- **Swollen abdomen, intestinal obstruction, weight loss, weakness, lethargy and anemia** may be seen. In heavy infections they can cause **occlusion of the gut, functional disturbances, retarded growth, increase the susceptibility of fish for other infection** and give the fish **an anaesthetic appearance**.
- **Diagnosis** is based upon the finding of adult worms in the intestine or invasive larvae within the body cavity. The shape of the proboscis, the number and arrangement of the hooks are also diagnostic features.

□ CLASS LEECHES (Annelida)

- Leeches are annelids: parasitic **segmented** worms belonging to the Class Hirudinea. These are visible on the fish's skin, gills, operculum. They are ectoparasites (primarily in freshwater, especially carps). Leeches are blood-feeders. Annelid worms have **anterior and posterior suckers**. Flattened or cylindrical, body segmented with anterior/posterior suckers. They are hermaphrodites.
- The genera *Piscicola*, *Hemiclepsis*, *Cystobranchus*, and *Actinobdella* have been reported from fishes. These leeches typically grow to about 3-5 cm in length. Most are predators or scavengers which feed on fluids or soft tissues of live or dead invertebrates. Parasitic leeches are blood sucking worms.

- **LIFE CYCLE IS DIRECT** with immature and mature worms being parasitic on host's blood. **Eggs** in cocoons are placed on **aquatic plants**. Young worms are ready to suck blood. Depending upon their size and number they can take a relatively large quantity blood, weakening the fish and creating a wound that may become infected. Heavy infestations may kill fish. Pathogenesis varies with number and size of worms and duration of feeding. Heavily infested fish often have chronic anemia.
- In heavily infected fish, fish become **restless, unusual movements, anaemia** and the affected area offer opportunities for **secondary infections**. In wintering ponds, fish **stop their rest** and **gather at the inflow**. They **grow thin**, and **their eyes and body become pale** due to blood loss. *Piscicola geometra* can directly cause the death of fish. However, they can also transmit **fungi, bacteria, virus** (spring viraemia of carp virus-SVCV) **and blood parasites** (*Cryptobia salmositica*-*Trypanoplasma*, *Trypanosoma*, *Piroplasma*). Less frequently, in some fish stocks, *Hemiclepis marginata*, can cause infections similar to *Piscicola*.

□ CLASS CRUSTACEA

