5

CHAPTER FIVE

Parasitic diseases and pests

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Aquaculture environments that are suitable for growth and reproduction of cultured animals are also hospitable to potential disease agents such as parasites. It is no wonder then that fish mortalities and abnormalities associated with parasites as disease agents are well documented, indicating their importance in aquaculture.

The study of parasites involves an understanding of certain existing relationships in a particular population. **Symbiosis** or "living together" is a relationship that benefits one or both parties. In **commensalism**, no party is harmed and both could live without the other. **Mutualism** is a relationship where both parties benefit from each other, and neither could live without the other. **Parasitism** is a one-way relationship in which one party (the parasite) depends upon, and benefits from, the other partner (the host), biochemically and physiologically.

Parasites live in a variety of environments. Those that live on the external surfaces (skin, fins, gills) of the host are called ectoparasites, while those found in the internal organs are called endoparasites.

This chapter deals with parasitic animals of significance to aquaculture because of their harmful effects on fish and crustaceans. It also discusses the various methods in diagnosing diseases caused by parasites, disease-prevention and control.

COMMON FISH DISEASES CAUSED BY PARASITES

Protozoan Infestations

Protozoans are unicellular, microscopic organisms with specialized structures for locomotion, food gathering, attachment, and protection. They can multiply on or within their hosts.

Ciliates have short, fine cytoplasmic outgrowths called cilia as the locomotory organelle. They are either attached or motile. Ciliates are mainly ectoparasitic.

CAUSATIVE AGENTS:

Ichthyophthirius multifiliis (50-1000 µm diameter) in freshwater (Fig. 5-1a)
Cryptocaryon irritans (60-450 µm diameter) in marine and brackishwater

The disease is known as Ichthyophthiriasis ("Ich") or White Spot Disease

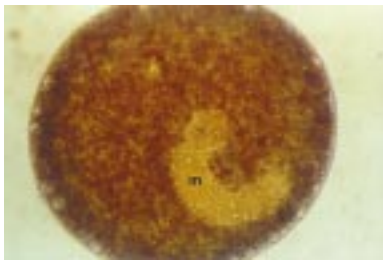

Figure 5-1a. *Ichthyophthirius multifiliis*, mature trophont, from skin of catfish *(Clarias macrocephalus)*. m, macronucleus (400x)

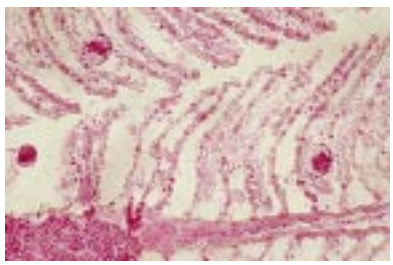

Figure 5-1b. *Cryptocaryon* in gills of fish showing epithelial hyperplasia (Hematoxylin and Eosin, 200x)

Figure 5-2a. *Trichodina* (silver nitrate stain, 400x)

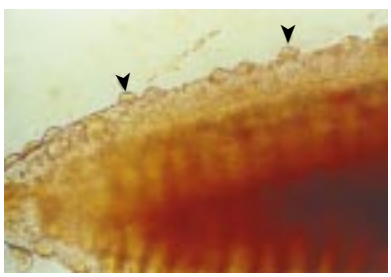

Figure 5-2b. *Trichodina* (arrowheads) on gills of grouper *(Epinephelus coloides)* (fresh mount, 200x)

SPECIES AFFECTED:

Catfish, carp, tilapia, seabass, grouper, snapper

GROSS SIGNS:

The disease is called "white spot" because of the presence of a few to numerous whitish or grayish spots on the skin and gills of affected fish which are actually nests of these parasites. Diseased fish lose their appetite, are lethargic, with dull, opaque or hemorrhagic eyes. Heavily infested fish produce a lot of mucus and they rub their body against the substrate or sides of tanks.

EFFECTS ON HOST:

This disease causes severe epizootic especially in intensive culture systems. The parasite may destroy the skin and gills (Fig. 5-1b). Ulcers may develop in the skin of heavily infested fish and may be the sites of secondary bacterial or fungal infection. Occurrence of this parasite is usually associated with a drop in temperature to 28°C.

DIAGNOSIS:

Encysted (0.10-0.35 mm) organisms appear as white spots on the surface of fish and can be seen by the naked eye. Microscopic examination of mucus from the body surface and gill filaments reveals round or oval parasites, propelled by cilia and possessing a horseshoe-shaped macronucleus in the case of *Ichthyophthirius*.

PREVENTION AND CONTROL:

For "Ich"

- Increase water temperature to 30°C for 6 h daily for 3-5 d
- 0.05% salt solution
- 100 ppm formalin for 1 h for 2-3 d
- 25 ppm formalin + 0.1 ppm malachite green
- Transfer infected stock in dry, parasite-free tanks for 2-3 times at 3 d interval

For *Cryptocaryon*

- 0.5 ppm $CuSO_4$ and 25 ppm formalin for 5-7 d, then transfer to dry, parasite-free tanks for 2 times at 3 d interval.

CAUSATIVE AGENTS:

Trichodina (45-78 µm diameter) (Fig. 5-2a), *Trichodinella* (24-37 µm diameter), *Tripartiella* (up to 40 µm diameter)

SPECIES AFFECTED:

Carp, tilapia, milkfish, seabass, mullet, siganid, grouper, snapper

GROSS SIGNS:

The parasites are attached mainly on the gills (Fig. 5-2b) and skin of the host. Affected fish appear weak with excessive mucus production and with frayed fins.

EFFECTS ON HOST:

Excessive numbers of the parasite on the skin and gills of infested fish may interfere with respiration. High mortality was observed among young fish. The adhesive disc can cause direct damage to the branchial epithelium resulting in gill lesions.

DIAGNOSIS:

Microscopic examination of wet mounts of gill filaments and scrapings from skin show saucer-shaped organisms, surrounded by cilia around its perimeter.

PREVENTION AND CONTROL:

- 2-3% salt solution for 2-5 min for 3-4 d (carp fry)
- 100% freshwater bath for 1 h for 3 d
- 100 ppm formalin + 10 ppm Acriflavin for 1 h for 3 d

CAUSATIVE AGENT:

Brooklynella (36-86 x 32-50 µm)

SPECIES AFFECTED:

Grouper, seabass, snapper

GROSS SIGNS:

The parasite attaches to the skin and gills of fish. Affected fish rub body against objects causing extensive skin damage and subcutaneous hemorrhage.

EFFECTS ON HOST:

May result to respiratory difficulties; may develop secondary bacterial infection

DIAGNOSIS:

Microscopic examination of mucus from body surface of affected fish and gill filaments show bean-shaped protozoans with long parallel lines of cilia that beat in waves.

PREVENTION AND CONTROL:

- 100% freshwater bath for 1 h for 3 days
- 100 ppm formalin for 1 h for 2-3 days

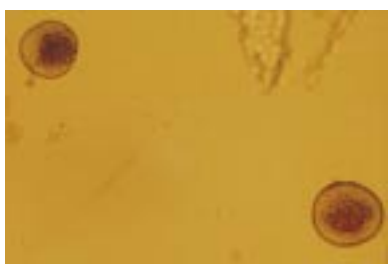

Figure 5-3a. Trophont of *Amyloodinium* fixed in Bouin's solution (200x)

Flagellates have one or more long, hair-like structures called flagella used as a locomotory organelle. They occur on the skin, gills, intestinal organs, and blood of fish.

CAUSATIVE AGENT:

Amyloodinium ocellatum (150-350 x 15-70 µm) (Fig. 5-3a, 5-3b)

SPECIES AFFECTED:

Mullet, siganid, grouper

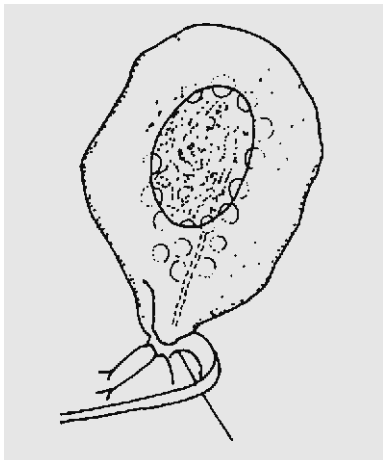

Figure 5-3b. *Amyloodinium ocellatum*, young trophont

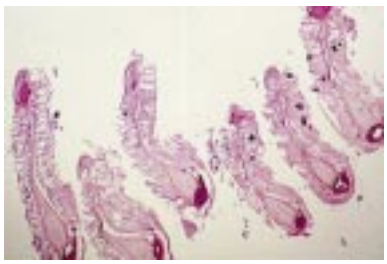

Figure 5-3c. Gill filaments of fish parasitized by *Amyloodinium* showing epithelial hyperplasia and disintegrating inner layer (Hematoxylin and Eosin, 100x)

GROSS SIGNS:

Heavily infested skin may have a dusty appearance ('velvet disease') with excessive mucus production. The parasite also attaches to the gills of affected fish. Fish rub body against objects in tanks. Affected fish exhibit abnormal surface swimming (spasmodic gasping and uncoordinated movements).

EFFECTS ON HOST:

This disease has been reported to cause morbidity and mortality in marine and brackishwater fishes. Heavy infestation can cause death within half a day. Histopathological changes include disintegration of the affected tissues (Fig. 5-3c), severe gill epithelial hyperplasia and reduced or absence of mucus cell.

DIAGNOSIS:

Microscopic examination of gill filaments or skin scrapings will reveal pear or ovoid-shaped trophonts with elongated red stigma near attachment site.

PREVENTION AND CONTROL:

- Use of sand filters; ultraviolet irradiation of rearing water
- Disinfection of culture facilities using lime
- Quarantine of new stocks
- Freshwater bath can cause parasite to drop off the gills
- 0.75 ppm $CuSO_4$ for 5-6 days
- 25 ppm formalin plus 0.1 ppm malachite green for 1 day
- 100-300 ppm formalin, 10 min

CAUSATIVE AGENTS:

Trypanosoma (18-32 µm) (Fig. 5-4a), *Cryptobia* (15 µm) (Fig. 5-4b), *Ichthyobodo* (10-15 µm) (Fig. 5-4c)

SPECIES/TISSUE AFFECTED:

Snakehead, carps, mullet, milkfish (blood)

GROSS SIGNS:

Affected fish have greyish-white film on fins and body surface, with frayed

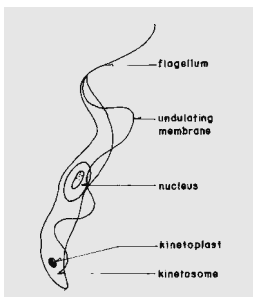

Figure 5-4a. *Trypanosoma*, adult stage

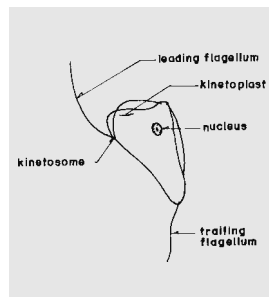

Figure 5-4b. *Cryptobia*

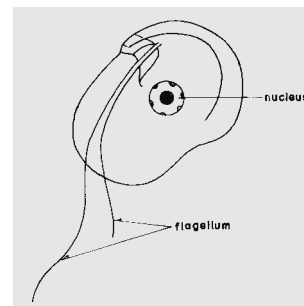

Figure 5-4c. *Ichthyobodo*

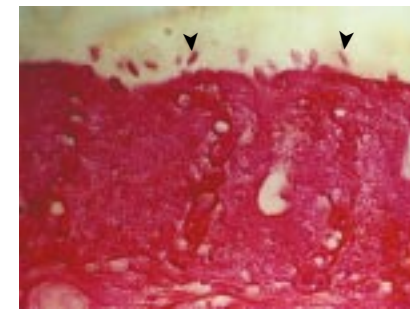

Figure 5-4d. Histological section of gills of snakehead *(Ophicephalus striatus)* with *Ichthyobodo* (arrowheads). (Hematoxylin and Eosin, 400x)

or destroyed fins. Fish rub their body against immersed objects or sides of the tank. *Ichthyobodo* is attached mainly on dorsal fins and gills (Fig. 5-4d) of the host. *Trypanosoma* and *Cryptobia* are parasitic on the blood of fish.

EFFECT ON HOST:

Affected fish show sluggishness, pale gills, and emaciated body. Fish parasitized by blood protozoans are usually anemic.

DIAGNOSIS:

For *Ichthyobodo*, microscopic examination of mucus from body surface and gill filaments. For blood protozoans, blood smears fixed in methanol and stained with Giemsa are examined under high power magnification (100x) of a compound microscope.

PREVENTION AND CONTROL:

- Drying of culture facilities
- Use of filters
- Elimination of the vector (leech) for blood protozoans
- Application of 10 ppt, 15-30 min or 2-5 ppm $KMnO_4$

Myxosporeans – the spore (7-20 µm) is the infective stage, and is composed of 1 to 7-spore shell valves, 1 to 2-sporoplasms and 2 to 7-polar capsules. Myxosporeans are parasitic in organ cavities and tissues of fish (Fig. 5-5).

CAUSATIVE AGENT:

Myxidium, Myxobolus, Henneguya, Kudoa, Myxosoma, Thelohanellus

SPECIES AFFECTED:

Mullet, catfish, eel, carps, climbing perch, snakehead

GROSS SIGNS:

White cysts are formed on skin, gills, muscle, brain, heart, ovaries, or other internal organs of fish. Myxosporean cysts produce thick milky exudate when ruptured.

EFFECT ON HOST:

Heavy gill infections may lead to respiratory dysfunction. Several cysts formed in the muscle may render the fish unmarketable. Heavy infection in internal organs may result to loss of equilibrium, skeletal deformities, and destruction of the host tissue.

DIAGNOSIS:

Microscopic examination of fresh smears of cysts containing many infective spores.

PREVENTION AND CONTROL:

- Isolate and destroy infected fish
- Disinfect rearing facilities with lime

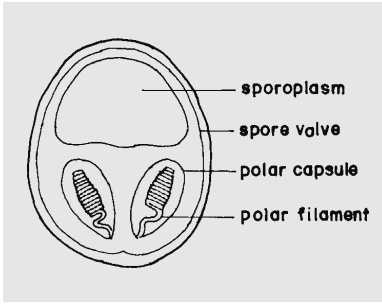

Figure 5-5. Generalized structure of a myxosporean spore

CAUSATIVE AGENT:

Sphaerospora (8.7 x 8.2 µm; with 2 spherical polar capsules)

SPECIES AFFECTED:

Grouper, seabass, marine catfish

GROSS SIGNS:

Affected fish exhibit swollen abdomen, exophthalmia and anemia.

EFFECTS ON HOST:

Spore stages are found in kidney, liver, gall bladder, and blood cells. Infected kidney tubules display severe vacuolation of the epithelium.

DIAGNOSIS:

Microscopic examination of fresh preparations of kidney and blood smears stained with Giemsa.

PREVENTION AND CONTROL:

Ultraviolet treatment of inflow water can control the infective stage, but is usually impractical

Monogenean Infestations

Monogeneans are ectoparasitic flatworms, < 1-5 mm long, with posterior organ of attachment called haptor armed with hooks and/or suckers (Fig. 5-6a)

CAUSATIVE AGENTS:

Gyrodactylus (Fig. 5-6b), *Dactylogyrus* (Fig. 5-6c), *Pseudorhabdosynochus* (Fig. 5-6d), *Benedenia* (Fig. 5-6e)

SPECIES AFFECTED:

Catfish, carp, tilapia, seabass, grouper, snapper

GROSS SIGNS:

Parasite attaches on gills (Fig. 5-6f), fins and body surface of fish. Affected fish have pale skin and gills with increased mucus production, frayed fins, and the cornea may become opaque.

EFFECTS ON HOST:

Heavy infestation may result to hyperplasia of the epithelial cells in the skin. Extensive damage to the gill epithelium may affect normal respiration. Heavy infestations may result in mortality. Conditions of low oxygen levels may increase mortality rates. Often associated with vibriosis.

DIAGNOSIS:

Gross and microscopic examination of gills and body surface of freshly sacrificed fish.

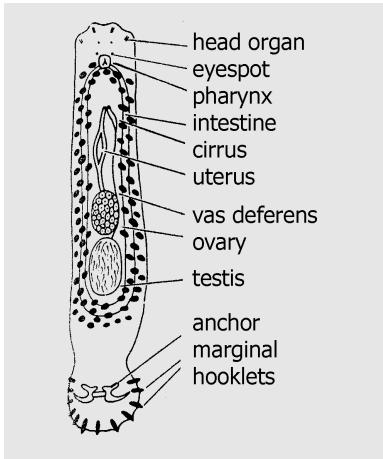

Figure 5-6a. Generalized structure of an adult monogenean

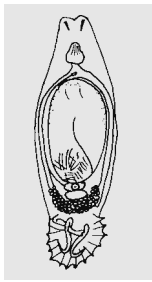

Figure 5-6b. *Gyrodactylus*

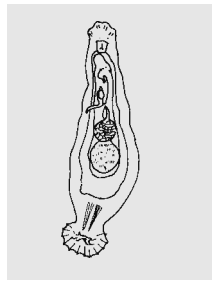

Figure 5-6c. *Dactylogyrus*

Figure 5-6d. *Pseudorhabdosynochus*

Figure 5-6e. *Benedenia* (fresh mount, 200x)

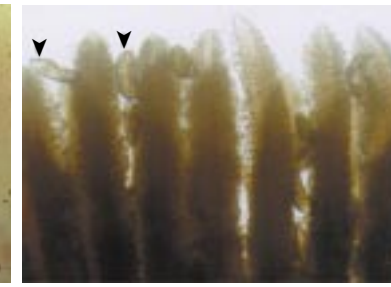

Figure 5-6f. *Pseudorhabdosynochus* (arrows) attached on the gills of grouper *(Epinephelus coioides)* (fresh mount, 100x)

PREVENTION AND CONTROL:

- Maintain optimum stocking density and adequate feeding
- 5% salt solution for 5 minutes
- Freshwater bath for 1 h for 3 days
- 100 ppm formalin for 1 h for 3 days
- 150 ppm hydrogen peroxide for 30 min

Digenean Infestations

Digeneans are endoparasitic flatworms measuring 1-2.6 x 0.2-0.8 mm with 2 sucker-like attachment organs located at the anterior and ventral portions (Fig. 5-7).

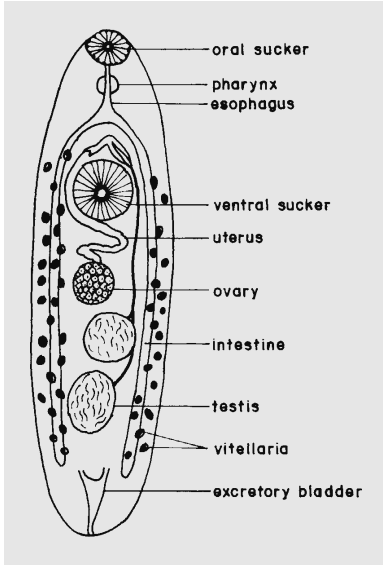

Figure 5-7. Generalized structure of an adult digenean

CAUSATIVE AGENTS:

Bucephalus, Lecithochirium, Pseudometadena, Transversotrema, Stellantchasmus, Haplorchis, Procerovum, Prosorhynchus, Hemiurus

SPECIES AFFECTED:

Bighead carp, grass carp, milkfish, seabass, grouper, siganid, mullet

GROSS SIGNS:

Presence of small, white to yellow or brown to black cysts on the skin, fins, gills, muscle, stomach or intestine. Affected fish have distended abdomen. Growth retardation has been observed in some cases.

EFFECTS ON HOST:

Affects growth and survival or disfigures fish. Disrupts function of vital organs. It may cause mild diarrhea to cardiac and visceral complications in humans (definitive host).

DIAGNOSIS:

Gross and microscopic examinations of the gills, muscle and internal organs for opaque or creamy cysts containing motile metacercariae.

PREVENTION AND CONTROL:

Elimination of intermediate host

Cestode Infestations

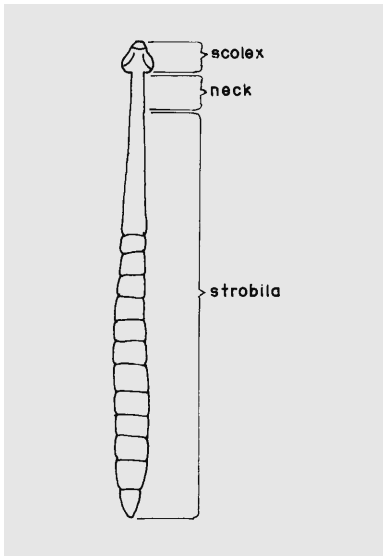

Figure 5-8. Generalized structure of a cestode

Cestodes are endoparasitic tapeworms, body is ribbon-like, segmented or unsegmented, 5-70 mm long and with an anterior attachment organ called scolex armed with hooks or suckers (Fig. 5-8).

CAUSATIVE AGENT:

Botriocephalus

SPECIES AFFECTED:

Carps, catfish, snakehead

GROSS SIGNS:

Affected fish are sluggish, with emaciated body because of non-feeding. This parasite is commonly found in intestine of fish.

EFFECTS ON HOST:

The parasite may induce hemorrhagic enteritis due to destruction of the intestinal epithelium. Adult stage of the parasite interferes with absorptive processes of the intestine and may reduce food intake. Secondary microbial infection is possible. Some fish cestodes are important human parasites.

DIAGNOSIS:

Gross examination of the intestine of host fish.

PREVENTION AND CONTROL:

- Elimination of intermediate hosts
- Disinfection of culture facilities with quicklime to destroy cestode eggs

Nematode Infestations

Nematodes are unsegmented roundworms (Fig. 5-9a, b, c); female, 7-21 x 0.18-0.8 mm; male, 3-9 x 0.1-0.5 mm

CAUSATIVE AGENT:

Spirocamallanus, Raphidascaris, Contracaecum, Echinocephalus

SPECIES AFFECTED:

Siganid, grouper, catfish, snakehead, goby

GROSS SIGNS:

Parasitizes the stomach and intestine of host fish. Affected fish have emaciated, discolored body surface and swollen intestine.

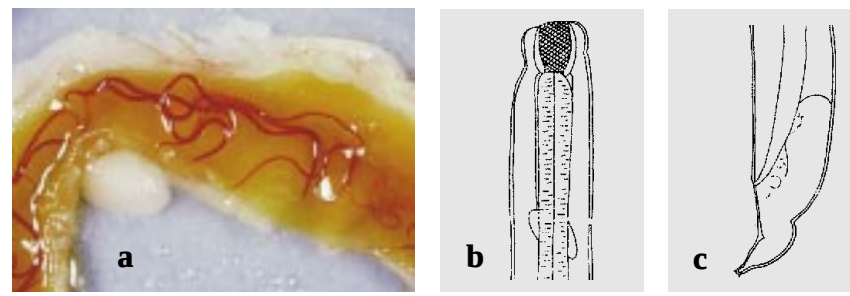

Figure 5-9a. *Spirocamallanus* in intestine of rabbit fish *(Siganus guttatus)*; **9b.** Anterior portion containing the head; **9c.** Female, tail

EFFECTS ON HOST:

May impair feeding, resulting in emaciation, growth retardation, and mild mortalities.

DIAGNOSIS:

Gross examination and dissection of the abdominal area reveals swollen intestine filled with liquid and large worms.

PREVENTION AND CONTROL:

- Elimination of intermediate hosts
- Drying of pond bottom
- Disinfection of culture facilities with quicklime to destroy nematode eggs
- Filtration

Acanthocephalan Infestations

Acanthocephalans are "thorny- or spiny-headed" elongated (10 mm long) cylindrical worms, having an anterior refractile proboscis with hooks (Fig. 5-10).

CAUSATIVE AGENT:

Acanthocephalus, Pallisentis

SPECIES AFFECTED:

Snakehead, catfish, eel, tilapia, milkfish

GROSS SIGNS:

The parasite is attached to intestinal mucosa of the host. Affected fish have darkened, emaciated body.

EFFECTS ON HOST:

The parasite causes necrotic hemorrhagic ulcers in the intestine of the host. Growth retardation and mortality have been reported.

DIAGNOSIS:

Gross examination of intestine reveals elongated and sac-like worms with retractile proboscis armed with spines.

PREVENTION AND CONTROL:

- Disinfect pond with quicklime
- Control of water supply and potential intermediate hosts
- Quarantine new and suspected stocks

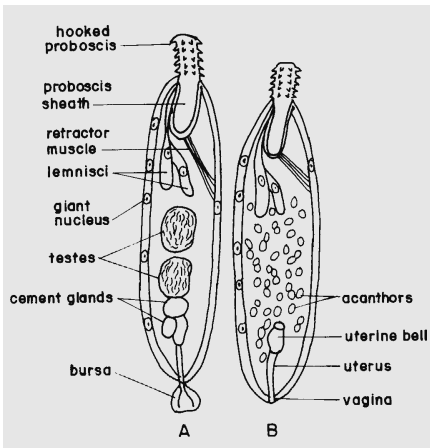

Figure 5-10. Generalized structure of an (a) adult male and (b) adult female acanthocephalans

Crustacean Infestations

Crustacean parasites have segmented bodies covered by shell with jointed appendages.

Argulus (fish louse) infestation – female, 6-6.5 mm; male, 2-3 mm

CAUSATIVE AGENT:

Argulus (Fig. 5-11)

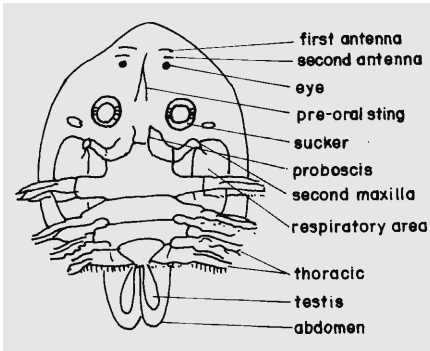

Figure 5-11. Generalized structure of an adult male *Argulus*

SPECIES AFFECTED:

Tilapia, milkfish, mullet, carp, snakehead, catfish

GROSS SIGNS:

Parasite attached to the skin, fins, buccal or opercular mucosa with two conspicuous black spots. Attachment area hemorrhagic or ulcerated.

EFFECT ON HOST:

Heavy infestation may result in mortalities. Wounds may become necrotic and ulcerated, paving the way for secondary bacterial infection.

DIAGNOSIS:

Gross and microscopic examination of host fish.

PREVENTION AND CONTROL:

- Use of filters
- 5 ppm KmnO4, 3-5 min
- 1 ppm Dipterex, 3-6 h

Caligus infestation (sea lice) – female, 3.9-5.1 mm; male, 2.85 mm

CAUSATIVE AGENTS:

Caligus epidemicus, Caligus patulus (Fig. 5-12)

SPECIES AFFECTED:

Milkfish, seabass, mullet, siganid, tilapia, snapper, spotted scat

GROSS SIGNS:

Transparent parasites appear like white patches, but are not permanently attached to the skin, fins, and gills. Infested areas have no scales, and are hemorrhagic or ulcerated.

Figure 5-12. *Caligus* from skin of snapper (fresh mount, 400x)

EFFECTS ON HOST:

Infested areas are hemorrhagic. The parasite can also cause skin ulcers. Mortalities after heavy infestations have been reported.

DIAGNOSIS:

Gross and microscopic examination of scrapings from possible infested area.

PREVENTION AND CONTROL:

- Freshwater bath for 24 h
- 0.25 ppm Neguvon for 12-24 h repeated at intervals of several weeks

Ergasilid infestation

CAUSATIVE AGENT:

Ergasilus (Fig. 5-13); 0.9-1.5 mm long

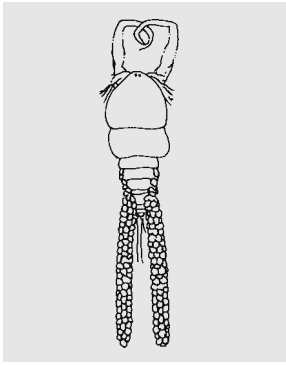

Figure 5-13. Generalized structure of an ergasilid, adult female

SPECIES AFFECTED:

Tilapia, carp, goby, seabass, grouper, mullet

GROSS SIGNS:

Parasite attaches to the gills and body surface of the host. White to dark brown copepods, < 2 mm long, some with 2 white elongated egg sacs are firmly attached to the gills. Affected fish have emaciated body.

EFFECTS ON HOST:

Destruction of the gill filaments resulting to respiratory dysfunction. Infestation of 10-70 parasites per fish can lead to 50% fish loss. Secondary bacterial infection is common.

DIAGNOSIS:

Gross and microscopic examination of host fish.

PREVENTION AND CONTROL:

- 0.15 ppm Bromex bath for 1 week
- 0.25-0.5 ppm Dipterex bath for 24 h

Lernaeid infestation – "anchor worm"; 1.2-1.4 mm long

CAUSATIVE AGENT:

Lernaea (Fig. 5-14)

SPECIES AFFECTED:

Milkfish, carps, tilapia, snakehead, goby

GROSS SIGNS:

Parasites observed protruding from nostrils, skin, bases of fins, gills, buccal cavity. Heavy infestation can result to loss of scale and skin ulcerations.

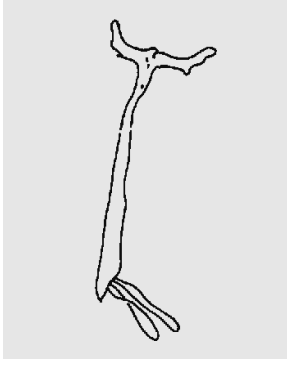

Figure 5-14. Generalized structure of lernaeid, adult female

EFFECTS ON HOST:

The skin and muscle are swollen. Ulcers may develop and result to muscle necrosis. The site of attachment may be a portal of entry for secondary microbial infection. Parasite attachment on the head may cause twisting and deformation of jaws. Affected fish suffer from serious weight loss. Mass mortality is not uncommon.

DIAGNOSIS:

Gross and microscopic examination of host fish. The body shape and attachment organ of the parasite have earned it its name – "anchor worm."

PREVENTION AND CONTROL:

- 3-5% salt solution for control of larval stages
- Adult stages may be eliminated through pond drying and liming

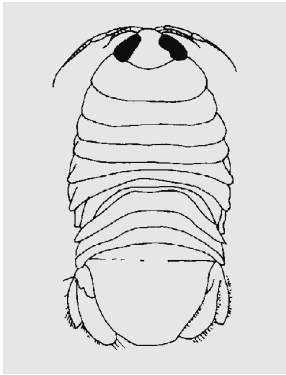

Figure 5-15a. *Alitropus*

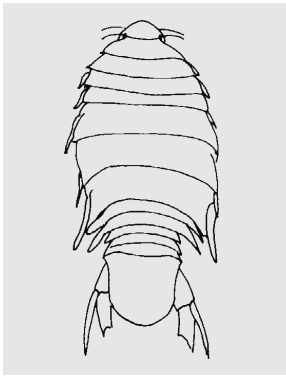

Figure 5-15b. *Nerocila*

Isopod infestation

CAUSATIVE AGENTS:

Alitropus (Fig. 5-15a), *Nerocila* (Fig. 5-15b); 2-3 cm long

SPECIES AFFECTED:

Tilapia, milkfish, seabass, mullet, siganid, grouper, goby

GROSS SIGNS:

The parasite attaches on the skin, mouth and gills of host fish. Clinical signs include reduced opercular movements, loss of appetite, anemia, and slow growth rate.

EFFECTS ON HOST:

The host tissue is destroyed brought about by the pressure of the parasite's body. There is necrosis of the dermis and the gill filaments. Swimming and feeding behavior are affected. Rapid death occurs in 1-2 days particularly in young fish.

DIAGNOSIS:

Gross examination of host fish.

PREVENTION AND CONTROL:

- Mechanical removal
- 200 ppm formalin bath until parasite detaches from the host
- Drying and liming of ponds for several weeks

Marine Leech Infestations

Figure 5-16a. *Zeylanicobdella arugamensis*

Figure 5-16b. Anal fin of *Epinephelus coioides* infested with *Zeylanicobdella arugamensis*

Marine leeches have striated bodies with muscular body wall, with anterior and posterior suckers, usually 8-12 mm long.

CAUSATIVE AGENT:

Zeylanicobdella arugamensis (Fig. 5-16a)

SPECIES AFFECTED:

Grouper, milkfish, tilapia

GROSS SIGNS:

Parasite attaches to the skin, fins (Fig. 5-16b), eyes, nostrils, operculum and inside the mouth. The attachment and feeding sites are hemorrhagic.

EFFECTS ON HOST:

The attachment areas are hemorrhagic. The parasite feeds on the host's blood and may result to anemia. Leeches act as vectors of viruses, bacteria and protozoan blood parasites.

DIAGNOSIS:

Gross examination of the host fish.

PREVENTION AND CONTROL:

- Use of filters
- Mechanical removal
- Complete drying of facilities
- 50-100 ppm formalin bath for 1 h

Mollusc Infestation

CAUSATIVE AGENT:

Glochidia is the larval stage of freshwater bivalve molluscs that may attach to fish. The margins of their shells have sharp teeth (Fig. 5-17).

SPECIES AFFECTED:

Freshwater fish

GROSS SIGNS:

The shell valves are attached to gills and outer surfaces of fish.

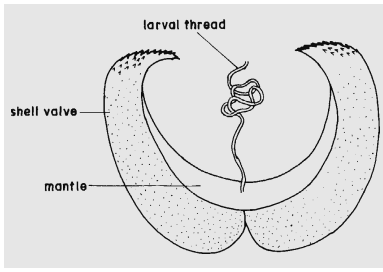

Figure 5-17. Generalized structure of a glochidium

EFFECTS ON HOST:

The gill tissue is destroyed. The respiratory function of the gills during severe infestations is disrupted. Secondary bacterial and fungal infections result when the parasite leaves the host.

Diagnosis:

Gross macroscopic and microscopic examination of the host fish.

PREVENTION AND CONTROL:

- Adequate filtration of intake water to prevent entry of larval glochidium

COMMON CRUSTACEAN DISEASES CAUSED BY PARASITES

Protozoan Infestation

CAUSATIVE AGENTS:

Vorticella (10-150 µm) (Fig. 5-18a), *Zoothamnium* (50-250 µm) (Fig. 5-18b), *Epistylis* (160 µm) (Fig. 5-18c), *Acineta* (35-55 µm) (Fig. 5-18d), *Ephelota* (250 µm) (Fig. 5-18e)

SPECIES AFFECTED:

Shrimps, crabs

GROSS SIGNS:

Heavily infested shrimp have fuzzy mat on gills and body surface.

Figure 5-18a. *Vorticella* (fresh mount, 400x)

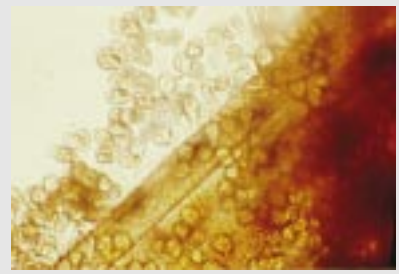

Figure 5-18b. *Zoothamnium* attached to the exoskeleton of shrimp (fresh mount, 200x)

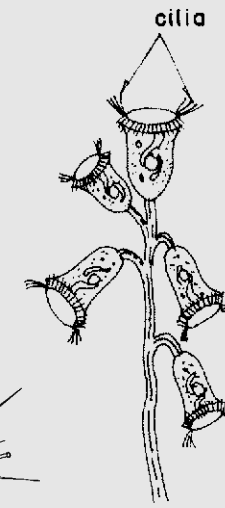

Figure 5-18c. *Epistylis*

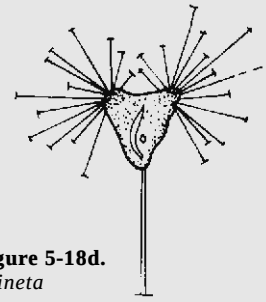

Figure 5-18d. *Acineta*

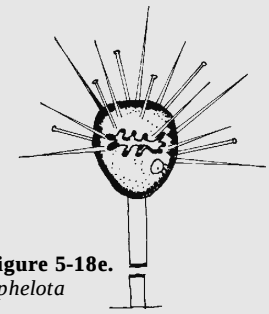

Figure 5-18e. *Ephelota*

EFFECTS ON HOST:

The parasites may cause respiratory and locomotory difficulties when present in large numbers. Heavy infestation may result in mortalities, particularly at low oxygen levels.

DIAGNOSIS:

Microscopic examination of wet mounts of shell and gill scrapings.

PREVENTION AND CONTROL:

- Removal of organic detritus
- Rigid sanitary control of rearing water
- For adult shrimps, 50-100 ppm formalin, 30 min (for *Zoothamnium*) or 30 ppm formalin (for *Epistylis*)

Sporozoans

Figure 5-19. Histological section of gut of *Penaeus monodon* juvenile with gregarines (G). (Hematoxylin and Eosin, 400x)

Sporozoans produce simple resistant spores with a special apical complex used in the invasion of the host cell. They can occur in the intestinal organs, muscle tissue and skin of fish.

CAUSATIVE AGENT:

Gregarines (3.5-4 x 8-16 µm) (Fig. 5-19)

SPECIES AFFECTED:

Penaeid shrimps

Gross signs:

Gregarines may be detected in the digestive tract microscopically.

EFFECTS ON HOST:

Large numbers of the parasite attached to filter apparatus of shrimp may possibly interfere with filtration of particles moving towards hepatopancreatic ducts or passing through the stomach. There is a considerable growth retardation. Infection rate in pond-grown shrimps was reported to reach 94%.

DIAGNOSIS:

Microscopic or histological examination of the digestive tract of the host.

PREVENTION AND CONTROL:

- In the hatchery, filter or chlorinate seawater used for rearing
- In grow-out ponds, eliminate the molluscan intermediate host

Microsporeans

These are intracellular parasites with unicellular spores (3-10 µm) containing sporoplasm and coiled polar filament (Fig. 5-20a).

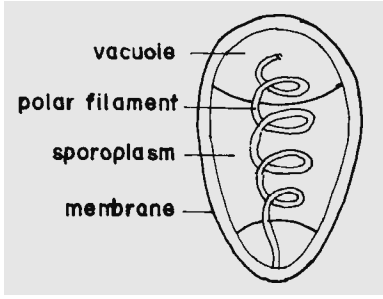

Figure 5-20a. Generalized structure of a microsporidian spore

Figure 5-20b. *Penaeus monodon* with white ovary disease

Figure 5-20c. *Penaeus merguiensis* with microsporeans on the abdominal muscle

CAUSATIVE AGENTS:

Nosema (Ameson), Agmasoma (Thelohania), Pleistophora, Glugea, Ichthyosporidium

SPECIES AFFECTED:

Penaeid shrimps

GROSS SIGNS:

Affected hosts are weakened and easily stressed. Infected areas (cephalothorax, abdominal muscle, ovary) turn opaque white because of the presence of spores and other stages of the parasite, thus the term “cotton” or “milk” shrimp or “white ovary” disease (Fig. 5-20b, 5-20c). Infection may result in sterility of spawners with white ovaries.

EFFECT ON HOST:

Penaeids with spores in the ovaries become sterile. In crabs, microsporidians cause lysis of muscle tissues and increase vulnerability to stress.

DIAGNOSIS:

Microscopic examination of fresh squashes of Giemsa-stained smears from infected areas will reveal spores. Histological sections also provide positive identification.

PREVENTION AND CONTROL:

- Isolate and destroy infected individuals
- Avoid contact of infected broodstock with offspring
- Disinfect culture systems with chlorine or iodine

LIFE CYCLE PATTERNS OF FISH PARASITES

Parasites may have a **direct life cycle**, that is, only one host is needed to complete the parasite's life cycle. Parasites may also have an **indirect life cycle** or they utilize more than one host to complete its life cycle. An **"intermediate host"** is one where the larval stages of the parasite usually develop while the **"final host"** is where the adult stage develops. The final host often feed on the intermediate host. A parasite may also stay in another host, a **"carrier or paratenic" host**, but does not develop in this host. Some parasites are host-specific. This means that they can parasitize only one or a limited number of host species. Parasites that are tissue/ organ-specific parasitize only a particular tissue or organ. An understanding of a parasite's life cycle patterns is useful in disease prevention, since the parasite may be eliminated at the weakest point of its life cycle.

Most protozoan have a direct life cycle. At the infective stages, they are released into the water to reinfect the same host or spread throughout the fish population (e.g. *Ichthyophthirius*) (Fig. 5-21). The blood parasites, e.g. *Cryptobia*, involve the leech, *Piscicola*, as the intermediate host, and are transmitted when the leech takes its blood meal.

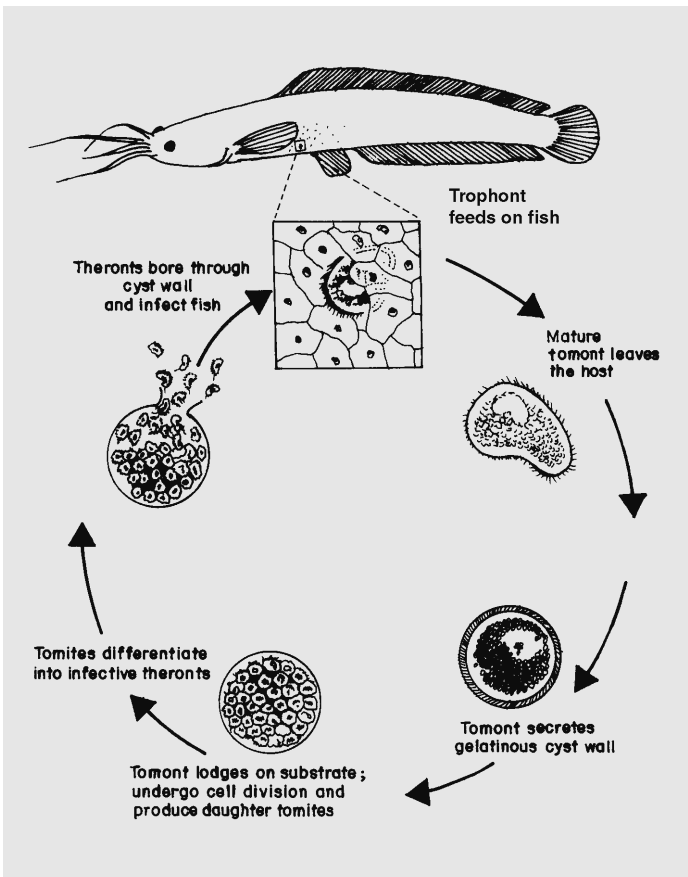

Figure 5-21. Life cycle of *Ichthyophthirius multifiliis*

Monogeneans have a direct life cycle. The free-swimming ciliated larvae **(oncomiracidia)** infect the host within a few hours. The parasites migrate to the final site of attachment and develop into adults (Fig. 5-22). An exception is the gyrodactylid, which bears live young (viviparous) instead of laying eggs. In this case, transfer takes place among fish through physical contact.

Digenean trematodes have an indirect life cycle. Adult parasites lay eggs (oviparous) and hatch as free-swimming larval stage **(miracidium)**. They can survive only for a few hours during which it must find and infect the first intermediate host, often a gastropod or a bivalve mollusc. **Cercariae** develop and encyst into **metacercariae** in a different intermediate host that is eaten by the final host where the adults develop (Fig. 5-23).

Cestodes are also oviparous and require one or more intermediate hosts. Eggs are passed in the feces and may or may not hatch in the water to release a free-swimming larva. The parasite develops further through various stages until finally turning into a **procercoid,** which can infect a fish host.

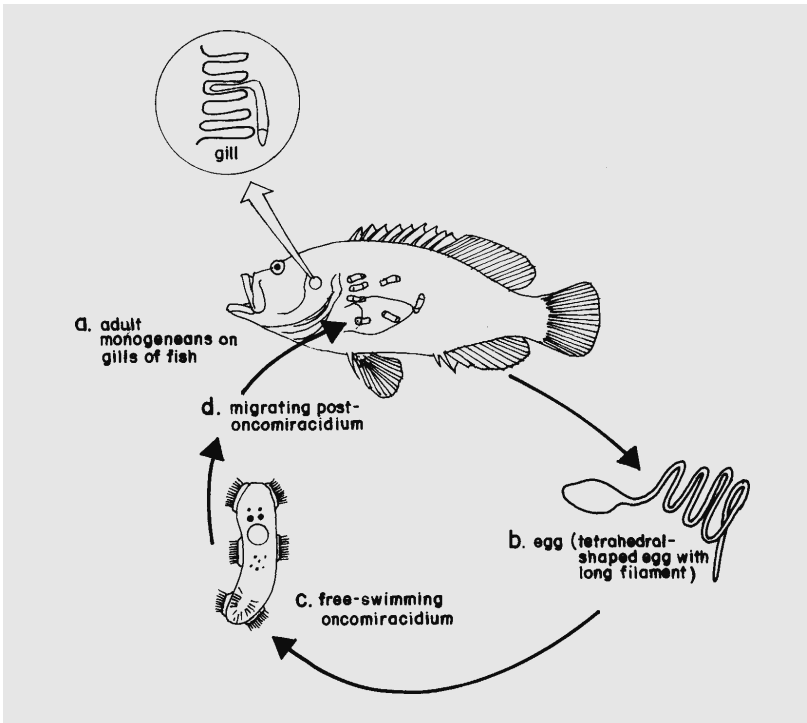

Figure 5-22. Life cycle of monogenean

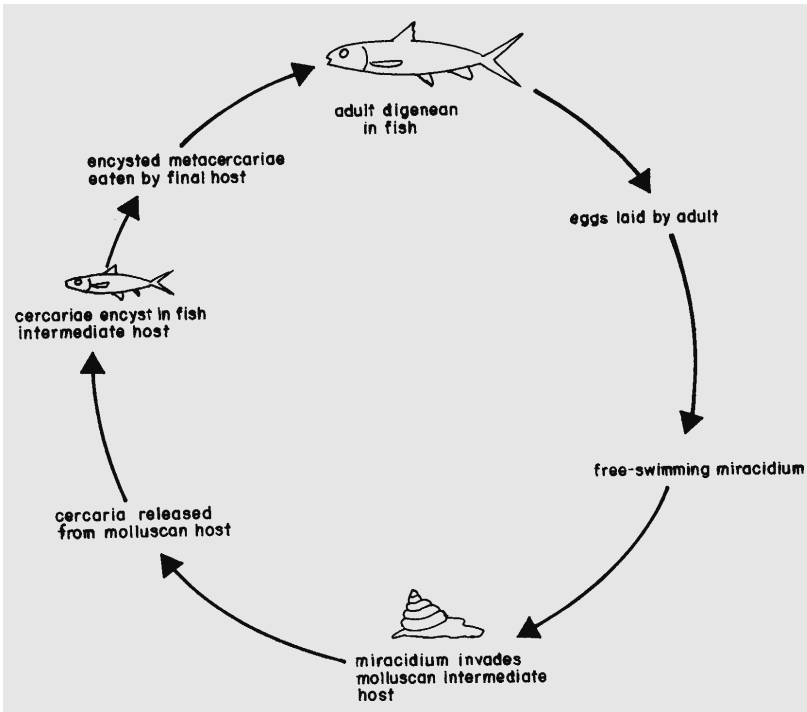

Figure 5-23. Life cycle of digenean

Nematodes are mostly oviparous. The intermediate host is usually an arthropod. The parasite may encyst in viscera and musculature of intermediate or paratenic hosts (Fig. 5-24). The females of orders Camallanoidea and Dracunculoidae are viviparous and release directly into the water.

Acanthocephalans also require an invertebrate host, usually an arthropod, to complete its life cycle.

The freshwater bivalve molluscs of the family Unionidae produce larvae *(glochidia)* which undergo an obligatory phase in the gills, fins or skin of the fish host. The parasitic phase may last for several months. The host tissue surround the parasite until it is shed from the fish, and grows into a free-living adult mollusc.

The mature female ergasilids are usually parasitic, while males are not. In caligids and lernaeids, some or all of the larval copepodid stages may be parasitic on an intermediate fish host or an individual of the final host species (Fig. 5-25). In other species, the males may be hyperparasitic on females.

The parasitic isopods utilize an intermediate host, e.g., a copepod, in their life cycle. In grass shrimp, for example, the female isopods may be found in the gill chamber with the dwarf male among its pleopods. The tiny male fertilizes the ova and the resulting larva swims toward the light, attaches to the copepod intermediate host and develops rapidly into another larval stage. The second stage larva molts and develops further into the larva (cryptoniscus) infective for grass shrimps. Isopoda belonging to the “cyomothoid” type attach to fish early in life and start as a male before developing into a female. Male-stage specimens cannot develop further in the presence of a ma-

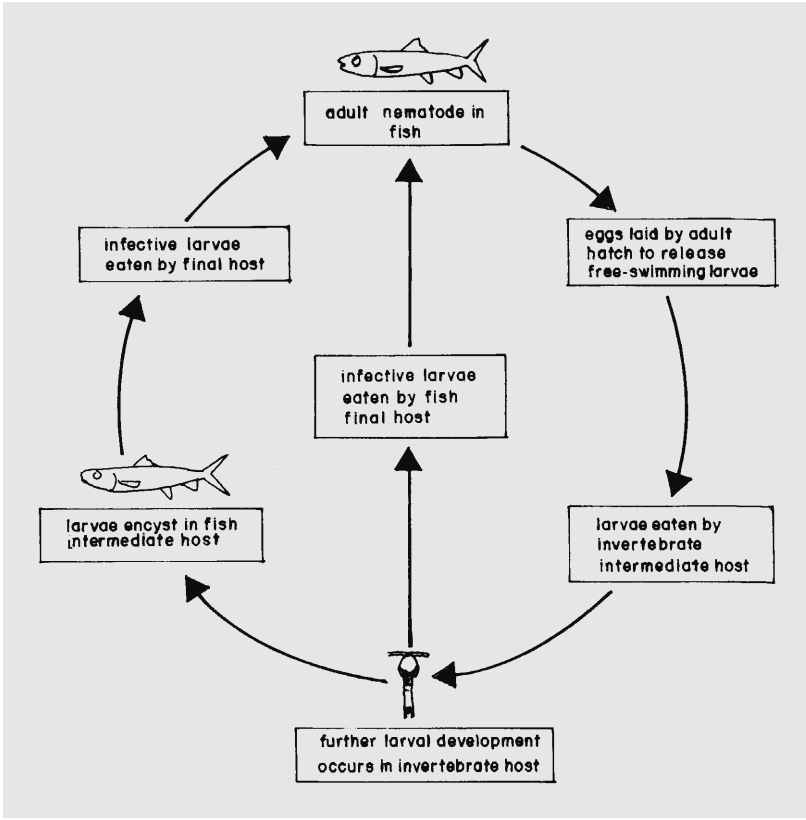

Figure 5-24. Life cycle of a parasitic nematode parasite

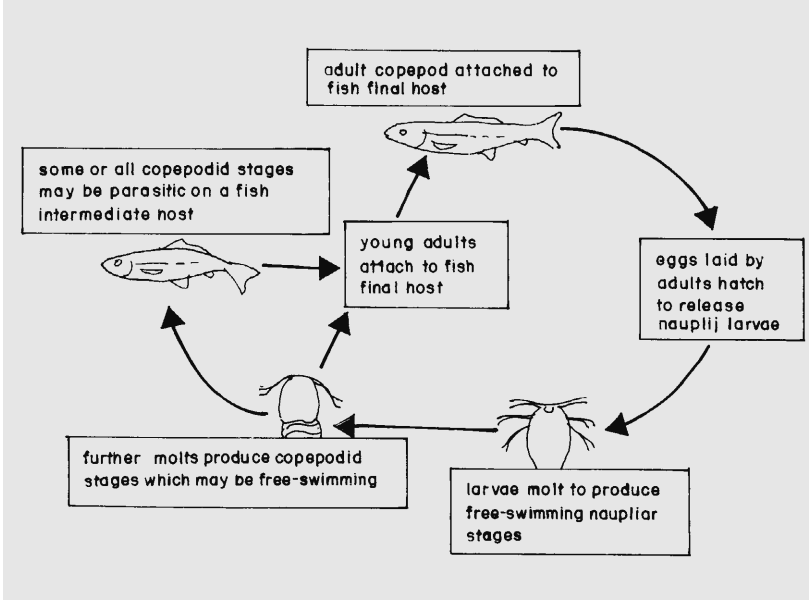

Figure 5-25. Life cycle of a parasitic copepod

ture female. "Gnathiid" isopoda are parasitic only during the larval stage known as praniza.

Leeches have a direct life cycle. Adults lay cocoons attached to a substrate. Young leeches hatch from cocoons and the life cycle is completed in more or less than a year's time.

SUMMARY

A wide variety of parasites have been identified as causing significant economic losses in fish and shrimp culture. Most of these parasites are difficult to control effectively with a single measure. The control of parasites is dependent on culture systems of the host fish, knowledge of the life cycle of the parasite, and the availability of effective treatment methods.

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