

Review on Major Parasitic Crustacean in Fish

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Abstract

In this paper the major description, epidemiology, pathogenesis and clinical sign, diagnosis, treatment and control of parasitic crustaceans in fish has been reviewed. The major crustaceans parasites commonly encountered in cultured and wild fish are: copepods (*ergasilidea* and *lermaeidae*), branchiura (*argulidae*) and isopods). Members of the branchiura and isopod are relatively large and both sexes are parasitic, while copepods are the most common crustacean parasites are generally small to microscopic with both free-living and parasitic stages in their life cycle. These parasitic crustaceans are numerous and have worldwide distribution in fresh, brackish and salt water. Most of them can be seen with naked eyes as they attach to the gills, bodies and fins of the host. They are increasingly serious problem in cultured fish and can infect wild population. Usually they cause only minor harm to their hosts when present in small numbers. However, in case of heavy infections severe damage to skin, muscles, and gills tissue accompanied with secondary infections, and resulting in decreased production. Good health management and good environment management are crucial in avoiding occurrence of crustacean parasites.

Keywords: Branchiura; Copepods; Crustaceans; Fish; Parasitic isopods

Introduction

Fishes are the great economic value for food, recreation, and aquarium use and also important to the ecology of water system [1]. Consumption of fish provides an important nutrient to a large number of people worldwide and thus makes a very significant contribution to nutrition [2]. Fish culture (farming) is a branch of animal husbandry dates back hundreds of years in Asia and Europe. Historically cyprinid fish species of Asian origin (e.g., various species of carps, trench and fish pleads) were adapted to fish farming parasites. Later, warm water species (e.g., cat fish: *Ictalurus*) were adapted to fish farming in the southern USA, hence being introduced to developing countries in Africa, and thus become a reliable source of protein in the human diet in this regions. Fish farming is currently practiced on all continents except Antarctica [3].

A tremendous number of crustaceans have evolved to become dependent on certain animal for existence. Those closely associated with fishes cause disease problem [4]. More than 45,000 species are known in the subphylum crustacean, including the well-known and delicious lobster, crab, and shrimp, as well as the lesser known smaller species that form a significant part of the fresh water and marine food chains and the parasitic species. Indeed, many parasitic species have free living larval stages that are part of the food chain [5]. Crustaceans have typically three tagmata, or body divisions: head, thorax, and abdomen. Often these regions are difficult to distinguish because of fusion of various parts [4,6].

Parasitic crustaceans are increasingly serious problem in cultured fish and can infect wild populations. Most parasitic crustaceans of fresh water can be seen with naked eyes as they attach to the gills, body and fins of the host [7,8]. Small crustaceans or copepods common parasites on the gills of aquarium and pond fish where they appear as

white spots. The gills become obstructed and fish die of anoxia [9]. When working with fish, disease prevention is always more rewarding than treatment. Once fish are sick accurately identifying all problems present can be difficult, and treatment must be administered early in the course of an epizootic to be effective. In most cases comprehensive program of fish health management should be based on the principle of water quality, nutrition, sanitation and quarantine [10]. Therefore the objective of this seminar was reviewing the common important parasitic crustaceans and Epidemiology of parasitic crustaceans in fish.

Common parasitic crustaceans in fish

There are main groups of parasitic crustaceans affecting commercially important aquaculture species, most of which are external parasites are the branchiura, copepod and isopod [11]. Members of the branchiura and isopod parasite are relatively large in both sexes, while copepod is the most common crustacean parasites and are microscopic with both free-living and parasitic stages in their life cycle [12]. Male parasitic copepods die after copulation in the pre-adult stages, so those that are seen attached to fish are generally mature females with distinctive paired egg sacs at the posterior end [11,13]. Parasitic crustaceans are numerous and have worldwide distribution in fresh, brackish and salt waters [13]. Usually they cause only minor harm to their hosts when present in small numbers. However, in case of heavy infections severe damage to skin, muscles, and gills tissue accompanied with secondary infections can occur [13,14].

Ergasilidae (Copepod)

Description is only sub adult and adult females occur in gills of fishes and a few genus paraergasilus are attached in the other than gills [15]. The cephalothorax constitutes half or more of the body length. The parasite body part is segmented with thorax (except the first segment, fused with the head) and the abdomen is distinct [13,15]. The second antenna terminal segment is hook-like in *Ergasilus* and three

clawed in a paraergasilus. Eggs are clustered in a bunch rather than arranged in a signal line (in coligoids) [15].

Epidemiology: *Ergasilids* vary in their level of host specificity; some are specific at least to their host genus (notably *Ergasilids* infecting *Cichlidae*). Others are less specific in their choice of hosts or are even opportunistic [14]. In African lakes and rivers, infections with *Ergasilids* are usually moderate. In habitats such as regressing pools in river beds at the dry seasons, confined fish may become heavily infected. It has been suggested that heavy infections serve as a contributing factor in mass mortalities of this fish occurring at times in the lake [15]. The fastidious, nutritive and the environmental requirement of the free-living stages seem to limit distribution of *Ergasilids* when their hosts are translocated. This is further emphasized by the fact that of the numerous species of *Ergasilus* and related copepod genera, very few ever become established in pond systems [16].

Life cycle: In *Ergasilidae* only the female is parasitic, and is found on the gills of fish. Males are free-living and there is a prolonged, free-living larval development which includes three to six stages of nauplii and four to six stages of copepodites (lasting from 10 days to over a month). These free-living stages feed on nanoplankton [14,15]. Females attached to gills produce eggs in two sacs which are attached to the genital segment. The number of eggs (20-100) is variable with species and apparently also with age and metabolic health as influenced by the location of attachment on the gills [15]. The time required for hatching is temperature dependent, 3-6 days in optimal ambient temperature. It has been established that elevated salinity delayed larval development [15].

Pathogenesis and clinical sign: Female *Ergasilids* feed on gill tissue and mucus, and then produce small foci of erosion [5]. Erosion and degradation processes may extend beyond the epithelial lining, resulting in obstructed bronchial blood vessels. Irritation often results in responsive hyperplasia of the epithelium, which, as infection is prolonged, may extend over large areas of the gills, causing fusion and embedding of lamellae, with a resulting decrease in the respiratory function of the gills [15]. Heavy infestations can result in mechanical damage, petechial haemorrhage, impaired respiration, epithelial hyperplasia, and anaemia with growth retardation. Severe gill damage is caused by the feeding activity of the copepod and this often leads to fish death [13].

Diagnosis: Diagnosis is based on finding a parasitic adult female with greatly enlarged second antennae attached to the gills of fish and observing clinical symptoms [5]. *Ergasilid* copepods are found on the body surface, gills and bronchial and nasal cavities of many fish species including sea bass, grouper, mullet, pearl spot, and tilapia, where it feeds on the blood and epithelium [14].

Treatment and control: *Ergasilus* can be treated successfully with a combination of 0.5 ppm copper sulphate and 0.2 ppm ferric sulphate for 6 to 9 days. A 3% salt dip, followed by 0.2% prolonged both for 3 weeks [8]. The best control method is not to introduce infected fish into lake and ponds [5]. Routine disease management measures such as reducing stocking density and water quality management are likely to reduce the impact of parasitic copepods. It is well recognized that a few unhealthy/stressed animals are more susceptible to infection and harbor the major of the parasites [13].

Lernaeidae (copepod)

Description stages except the parasitic females have typical copepod structure [5]. The rod-shaped, unsegmented, or partly segmented parasitic stage lernaeid female is anchored, with the aid of a specialized holdfast organ, to the host skin or buccal mucosa. Differentiation to lernaeid genera and to species in the genus *Lernaea* is based mainly on the morphology of the holdfast organ (anchors) of the parasitic females. The growth and branching of the latter, however, is greatly affected by the consistency of the tissue into which the holdfast organ is anchored [15]. The parasitic female embeds her anterior end in fish flesh and grows from about 1.5 mm to over 10 mm in length in about a week. The first thoracic segment enlarges greatly forming the "anchor," which permanently, secures the parasite in the host tissues. The anchor consists of two ventral processes and two branched dorsal processes.

All thoracic segments enlarge greatly, but the swimming legs do not, so that the legs become difficult to see and the female takes on a worm like appearance. Mature females have two eggs sacs immediately posterior to the pregenital prominence [5]. Copepodites of lernaeids attached to gills are readily differentiated from *Ergasilid* parasitic females in lacking the hook (Spine) type terminal segment of the second antenna [11,15].

Epidemiology: *Lernaea cyprinacea* is an opportunistic species which infecting the fishes of many families and widely distributed in Eurasia, North America and Southern Africa mainly via translocation of edible ornamental cyprinids [15]. Secluded habitats such as small dams and fish ponds accelerate risks of infestation. Infection is usually low to moderate (up to 28% some habitats). At times, however, in some dams infection becomes extremely severe [15].

Life cycle: Parasitic copepods have a complex life cycle with different larval stages; between each of which is a molt [13]. There are three naupliar stages, five copepod stages, a pre-adult and adult stage in the life cycle. Earlier literature suggested that two hosts were needed to complete the life cycle, but in more recent studies both copepod and adult females were found on the same host; suggesting that at least some can complete the life cycle on one host. In cooler climates there may be only a single generation per year, whereas in warmer climates the life cycle can be completed in 12 to 14 days [5].

Pathogenesis and clinical sign: Anchor worm infections produce granuloma or necrotic lesions and are later transformed into fibrotic encapsulation of the fish tissue around the anchor [16]. Pathogenicity of *Lernaeids* largely depends on their host size, number of parasites and their attachment site preferences. Infection by a single or 2-3 female is very damaging or even deadly to young or small fish in the liver, intestine or brain [5,15]. The ubiquitous skin *Lernaeids*, such as *L. cyprinacea* and *L. hardingi*, cause severe damage only in the heavy infections [15]. Hemorrhage and ulceration are common [5,10]. Frequent rubbing or "flashing", inflammation on the body of fish, tiny white green or red worms in wounds, breathing difficulties and general lethargy; retarded growth, anaemia, epithelia hypertrophy, restlessness and finally death. Major injury is caused by loss of blood and by secondary infection with bacteria, fungi and other organisms [5].

Diagnosis: Anchor worms can be seen with the naked eye as they protrude from various sites on fishes and microscopic examination of scrapings from skin, gills and fins, from affected fishes and by observing general clinical symptoms [5,13].

Treatment and control: *Lernaea* is extremely difficult to control because only the free living larvae are susceptible to treatment [13].

Although control is not easy, some steps can be taken to reduce losses chemical control, inspection of introduced fish and cleaning the environment once an outbreak has occurred [5]. Only partial control of *Lernaea* is possible with chemicals. Because, the head is buried in the fish tissues and there are no exposed respiratory organs. Hence, prevention is more effective than control. 1% of common salt eliminates larvae in 3 days, 250 ppm formalin for 30 to 60 minutes [3]. Other chemicals such as organophosphate and organ halogen insecticides, dip in potassium permanganate (KMnO₄), kills attached female *Lernaeids* [16]. Recently the insecticide Dimpling (R) (Philips Duper, Netherlands product) was found effective against adult female at concentration of 0.03-0.05 ppm. This insecticide has not been cleared for use with food fish and its degradation in the environment is slow so that contaminated water should not be released until at least 30 days after treatment [15]. Removal of the parasite by hand with forceps may control *Lernaeidae* infections with careful monitoring of the wound [14].

Argulidae (Branchiura)

Description of Argulids ("Fish lice") body comprises a head of five limb-bearing segments and a trunk, divided into a thoracic region carrying four pairs of strong swimming legs, and a short abdomen, comprise of a single bi-lobed unit (caudal fin) [17]. Dorso-ventrally flattened and covered dorsally by a rounded or horseshoe shaped carapace. Ventrally positioned head appendages are developed for attachment. Only one species of *Dolops* is present in Africa, it differs from *Argulus* in having the second maxilla armed with a hook rather than a sucker, characteristics of the latter [18]. *Chonopeltis* are usually the smallest; head appendages are feeble and rudimentary, the mouth tube found in the other Argulids is absent, whereas the cup-like sucker of the second maxilla is distinctly developed. The carapace is reduced in size and width. Unlike the above Argulids, which are active swimmers, *Chonopeltis* is not capable of swimming if removed from the host [19].

Epidemiology: Twenty nine endemic species occur in Africa, in fish of diverse families. *Argulus africanus* and *Dolops ranarum* are opportunists and occur in diverse fish in all major systems of Africa. Allied species, *A. rhiphidiophorus* and *A. cunningtoni*, replace *A. africanus* in some East African lakes connected to the upper Nile, and co-exist in others, in part at least, due to later artificial introductions of fish. *Argulus* species are lice commonly found on aquarium, pond-reared, and wild fish. The remaining, including members of the genus *chonopeltis*, is host specific with a restricted distribution to a single water system [10].

Dolops ranarum is the only ubiquitous argulid potentially pathogenic to farmed fish. *Lates albertianus* of lakes Albert and Kyoga and of the Victoria Nile are infected with *D. ranarum* [15]. In Israel *A. japonicus* is exposed to a serious pest of farmed carp, for several years had rarely been found on pond reared carp [15].

Life cycle: Species of *Argulus* and *Dolops ranarum* are parasitic throughout life, but leave the host to moult or to lay eggs, and during this process will also change hosts. Both males and females may survive free living for as long as 15 days [18]. *A. africanus*, *A. cunningtoni*, *A. rhiphidiophorus* and *D. ranarum* have a preference for smooth-skinned fish (siluriforms and lung fish), the same species may, however, infect buccal and opercular mucosal integuments of scaly fish, notably cichlids [15]. The sexes are separate and in most brachiurans males transfer sperm directly to the females using a variety of modified structures on the third and fourth thoracic legs

[17]. Mating takes place while they are free-swimming [15]. In fresh water species, after taking a meal, a mature female *Argulus* will leave its host and began to lay eggs in rows on any hard, submerged surface. These eggs hatch into free-swimming larvae. These larvae function as a dispersal phase and molt into the second stage. The first larval stage lasts about six days and moults occur at intervals until maturity. Branchiurans are parasitic from the second larval stage onwards but appear to leave the host and then find a new host of intervals throughout development [17].

Pathogenesis and clinical sign: Brachiurans damage the fish directly by extracting blood and vital tissue fluids from the host with their modified mouth parts. The mode of feeding of *Argulus* involves secretion and injection of relatively large quantities of digestive fluids, which are toxic to the fish. The sting of one fish lice can kill a small fish [17]. Feeding sites become hemorrhagic ulcerated and provide access to secondary infections by other pathogens. Mucus is secreted when skin, fin and gills become infected [20]. Persistent irritation caused in heavy infections may affect fish appetite with resulting anorexia, and cessation of growth, scratch itself against rocks or repeatedly jump out of the water in an effort to dislodge the parasites and erratic swimming [16,20].

Diagnosis: It is possible to see the parasites with a naked eye, range in length from a few millimeters to about 30 mm [17,20] and microscopically observe the clinical sign like, hemorrhages and ulcerative skin and gills [8].

Treatment and control: The treatment of *Argulus* infestations include the use of common chemical such as salt (NaCl) and other common chemicals used in experimentation include formaldehyde, potassium permanganate (2-5 mg/l bath) and formalin [20,21]. The most effective treatment against argulosis is organophosphates. Organophosphates usually 2-3 doses at one week intervals, are needed to treat the emerging larvae and juveniles. Treatments such as trichlorfon (0.25 ppm for several hours) and emamectin benzoate have been used to eradicate *Argulus* [10,20]. Individual parasites can be removed from fish with forceps, but this does not eliminate parasites in the environment [3]. To control *Argulus*, remove the submerged vegetation, wooden lattice placed in the pond will serve as artificial substrate to deposit its eggs, which can be removed at intervals to kill the eggs [22]. The keys to prevention are avoidance and quarantine [20].

Description parasitic isopod

Isopoda are the largest crustaceans found on fish (20-50 mm long). The body consists of three regions; the head is unsegmented and bears two pairs of antennae, a pair of variable sized eyes and mouth. A second region, the peraeon, of 7 segments, each with a pair of legs (peraeopods) and third region, pleon, of 6 segments with pair of pleopods, except the last which together with biramous uropods form a swimming tail pleotelson [15]. Parasitic isopods are typically marine, and usually inhabit the warmer seas [23]. Most of them are ectoparasites. There are three major groups: cymothoids, epicaridians and gnathiids. Cymothoids are parasites of fish, both as immature forms and adults. Epicaridians are parasites of crustacean again as immatures and adults. Gnathiids are larval parasites of fish, the adults being free living and non-feeding. Genetically, the cymothoids and epicaridians appear to closely relate whereas the gnathiids appear to have evolved from different isopod line [17].

Epidemiology: Parasitic isopods are typically marine, and usually inhabit the warmer seas [17] and infections have been reported in euryhaline fish in estuaries. A few species of Cymothoid isopods (*Lironeca* spp) occur in African freshwater fish (apparently as marine relics) in the Congo basin (in cichlid, a clupeid and a citharinid) [15]. Opportunistic euryhaline cymothoids of several families and genera infect farmed fish in South East Asia, including cultured tilapia [16].

Life cycle: The cymothoidae life cycle involves only one host (Holoxenic cycle) [23,24] and attach to fish early in life and pass through a male stage before becoming female. The presence of a mature female prevents male stage specimens from further development [15,17]. Both males and females remain permanently attached to the fish. Egg and larval development takes place in a special brood-pouch on the female's ventrum [24]. Another group, the gnathiid isopods, is marine and only parasitic during the larval stage [15].

Pathogenesis and clinical sign: Cymothoidae are blood feeding. Several species settle in the buccal cavity of fish, others live in the gill chamber or on the body surface including the fins [23,24]. *Cymothoa* spp are causes serious problems in fishes kept in captivity or cages. The damage caused by them resembles that of other copepods but the most serious effect of isopod infection is destruction of host tissue resulting from the pressure of the parasites body [25]. The degree of damage to fish varies with the site of attachment and ratio between the isopod and the host [15,23]. Lesion to the integument causes hyperplasia, or desquamation and later on dermal inflammation and necrosis [15]. The parasite can also impede opercular respiratory movements [16]. As cymothoids penetrate the skin with their pereopods and mouth parts, and the tissue inhabiting forms maintain a small opening to the outside, secondary infections occur. The wounds they cause may provide entry points for microbial diseases [24].

Diagnosis: Grossly observation of the parasites on the skin, mouth or in the gill chamber with associated lesions. The hemorrhagic and necrotic head tissues are evident when observing the fish in their cage. When the sick fish are removed from the water, several isopod larvae may be seen in their buccal and gill cavities and /or on the skin near the opercula [11].

Treatment and control: No specific control or therapeutic measures against isopods have been in practice except the manual removal of the parasite and by implementing optimum management practices during culture as infection by the planktonic phase is the common feature [13]. However, chemical treatment for cage culture is not practical; Trichlorfon (Dipterex) at a concentration of 0.5-0.75 ppm for 24 hour is recommended for pond treatment [11].

Conclusion and Recommendations

The major crustaceans parasites commonly encountered in cultured and wild fish are: copepods, branchiura and isopods. These parasites are numerous and have a worldwide distribution in fresh, brackish and salt water aquaculture systems. Their harmful effects on fish are: destroying tissue, removing blood and cellular fluids, diverting part of its nutrient supply and can weaken a fish and predispose to other infections. The severity of these diseases is depending upon: The life stage, species and number of crustacean present; the age and species of fish; and the sites of infection. Anything that increases stress on individual fish can cause an outbreak of diseases. Once fish are sick, accurately identifying all problems present can be difficult, and treatment must be administered early in the course of an epizootic to

be effective. In most cases comprehensive program of fish health management should be based on the principle of water quality, nutrition, quarantine and sanitation (includes maintenance of clean environment, proper disinfection of nets and equipments).

Based on the above conclusion the following recommendations are rewarded:

- Veterinarians need to have full information and more knowledge about crustacean parasites,
- Care should be taken while introducing the new fish to the population,
- Education of the fish culturist farm men to develop modern management practices in such a way that fish could get good nutrition, good health care and better housing,
- Studies on the life-history and physiology of crustacean parasites to use the suitable and appropriate chemical (drug) at the proper time, and
- Wrong treatment because of misdiagnosis is a waste of time and money and maybe more detrimental to the fish than no treatment at all. In addition it enhances development of drug resistance.

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