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SHORT COMMUNICATION

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Problems caused by isopod parasites in commercial fishes

Ganapathy Rameshkumar · Samuthirapandian Ravichandran

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Abstract Crustaceans are found in every type of aquatic ecosystem, and there are species adapted to extremes of temperature, pressure, salinity, and even anoxia. Parasitic isopods are typically marine and usually inhabit the warmer seas. They 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. Isopods can cause morbidity and mortality in captive fish populations. The damage of gill filaments thus was not only due to the feeding but also by the pressure exerted by the dorsal side of the parasite. Erosion of gill lamellae, damage of gill rakers and pale gills were the severe gross lesions observed as a consequence of isopod infestation. Infested fish exhibited histopathological anomalies such as tissue reactions, primarily associated with the formation of granulomas consisted of macrophages and epithelioid cells, which are occasionally surrounded by a thin rim of fibroblasts. A marked increase in the size of the parasite is associated with the development of marsupium full of juvenile parasite. The infestation usually pressure atrophy often accompanies the presence of larger parasites. They may lead to economic losses in commercial species of fish. Thus, treating fishes infected with isopods without treating their environment may only provide temporary relief. It is also important to recognize the potential for secondary infections associated with severe isopod infections.

Keywords Parasitic isopods · Fishes · Effect · Prevention · Treatment

G. Rameshkumar (✉) · S. Ravichandran
Centre of Advanced Study in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai 608 502, Tamil Nadu, India
e-mail: grkumarcas@gmail.com

Parasitic isopods

Parasites are invertebrate organisms; some are free-living and can become opportunistic parasites; others require hosts for their survival and reproduction, and these are referred to as obligate parasites. Both opportunistic and obligate parasites are found in fish hosts but most parasitic diseases in fish are generally caused by obligate parasites. Crustaceans are found in every type of aquatic ecosystem, and there are species adapted to extremes of temperature, pressure, salinity, and even anoxia. Intertidal and tidal pool species are especially adaptable, with individuals experiencing extensive temperature fluctuations and periodic drying on a daily basis. Besides living in virtually every aquatic habitat on earth, crustaceans also make their living in almost every conceivable way. Crustacean ectoparasites on marine fish are diverse. Isopods form an order in the crustaceans.

Parasitic isopods are typically marine and usually inhabit the warmer seas. Their body form varies from an easily recognisable isopod to a relatively amorphous sac recognised as an isopod only from the less modified male found within the folds. Though free-living isopods tend to be detritivores, parasitic forms feed on host blood or host hemolymph. Their mouthparts form a cone with maxillipeds that tear at the flesh and tiny pointed mandibles that pierce into the tissue to penetrate blood vessels or blood sinuses. The gut, particularly the hind gut, is quickly filled; often swelling the body, then the contents are slowly transferred to the midgut glands for digestion. Thus the parasites tend to be intermittent feeders. They can be a major drain on the host, frequently affecting reproductive performance and sometimes affecting growth rate.

Most parasitic isopods are ectoparasites. There are three major groups: cymothoids, epicaridians and gnathiids.

Fig. 1 Female isopod *Mothocya renardi* in the branchial region of *Strongylura leiura*

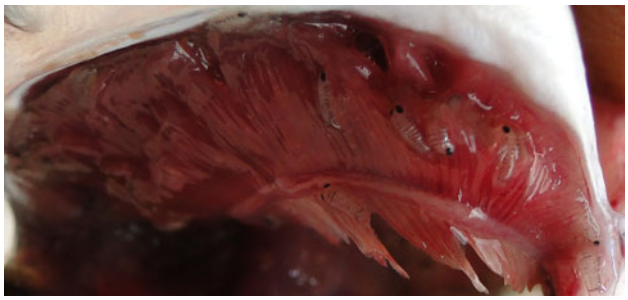

Fig. 2 Juveniles of *M. renardi* in the gill region of *S. leiura*

Cymothoids are parasites of fish, both as immature forms and adults. Epicaridians are parasites of crustacea, again as immature and adults. Gnathiids are larval parasites of fish, the adults being free living and non-feeding. Genetically, the cymothoids and epicaridians appear to be closely related whereas the gnathiids appear to have evolved from a different isopod line.

Problems caused by isopods

Many species of fish are infected by cymothoids (crustacea, isopoda, and cymothoidae). They 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. Their life cycle involves only one host (holoxenic cycle). Isopods associate with many species of commercially important fishes around the world and cause significant economic losses to fisheries by killing, stunting, or damaging these fishes. They can also kill or impair immature fishes so that they do not survive. Isopods serve as important food items for a variety of animals. They are commonly seen on teleosts in tropical and subtropical waters (Brusca 1981; Ravichandran et al. 2000, 2007; Rameshkumar et al. 2011, 2012a, b). They resemble free-living isopods except for their hook-like legs. The stages normally found are the non-swimming, permanently attached mature females, often with a small male nearby.

Isopods can cause morbidity and mortality in captive fish populations. As direct agents of disease their feeding and attachment activities can cause organ and tissue damage (including blood loss) and osmoregulatory problems, and they can vector pathogens, i.e., viruses, bacteria, blood-born protozoa, and nematodes (Davies 1982; Ravichandran et al. 2001; Ravichandran and Ajith Kumar 2007). As indirect promoters of disease they cause lesions and stress that can predispose hosts to opportunistic pathogens, e.g., bacteria and fungi. For more information on problems caused by isopods see (Kabata 1970, 1984; Honma et al. 1991; Lester and Roubal 1995).

Effect on the respiratory surface area

The damage of gill filaments thus was not only due to the feeding but also by the pressure exerted by the dorsal side of the parasite. The gross size and shape of parasites can act as physical irritants that may be responsible for the observed damages of the branchial tissues (Figs. 1, 2). The reduction in the surface area was thus due to several factors such as the mode of attachment, movement, size and duration of stay of the parasites (Ravichandran 2007; Ravichandran et al. 2007).

Erosion of gill lamellae, damage of gill rakers and pale gills were the severe gross lesions observed as a consequence of isopod infestation. Pale gills of infested fishes indicated anemia, which may be due to loss of blood the obstruction of branchial circulation by the attachment of parasite and of the homophagous nature of the branchial cymothoids (Romestand et al. 1977; Romestand 1979). The callus like thickening observed on the gill arch and gill filaments may be due to the constant irritation caused by the body and appendages of the parasite. Stephenson (1976) reported callus-like thickening only between the gill rakers, but in the present study, its occurrence was noticed not only at the gill arches but also at the base of the gill filaments. This extra thickening on the gill arches could be related to constant irritation caused by the body of the parasite.

Thickening and erosion are the two unique morphological changes noticed owing to the infestation. These changes were mainly due to the heavy pressure exerted by the parasite and also by their feeding nature. Kabata (1985) observed destruction of host tissues as a result of the pressure exerted by the parasite's body. Longer stay of parasite within the gill chamber may also prevail and obstruct the

normal growth of the gill arches. This may be the reason for the torsion of gill arch and fusion of gill lamellae.

Infested fish exhibited histopathological anomalies such as tissue reactions, primarily associated with the formation of granulomas consisted of macrophages and epithelioid cells, which are occasionally surrounded by a thin rim of fibroblasts (Figs. 3, 4). The lipofibrosis observed at the inner surface of the operculum was semihard and the surface was finely granulated and, showed invasive tendency. Accumulation of deeply stained acidophilic plasmacytes, marked separation of hyperplastic growth, perfuse infiltration of lymphocytes and granulocytes are the characteristic features of the lipofibrosis noticed in the present study. Earlier workers indicate the presence of hyperplastic and hypertrophied reactions a function of infection due to isopod parasites (Eller 1975; Romestand et al. 1977; Rand 1986; Ravichandran et al. 2007).

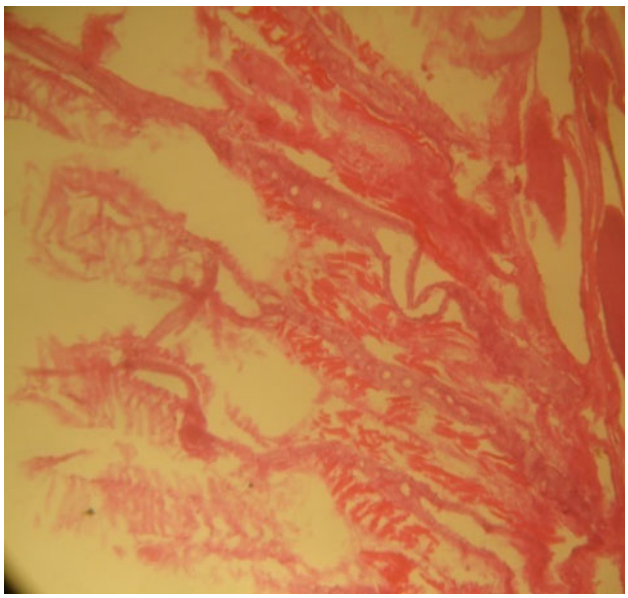

Fig. 4 Damage of gill raker and gill lamellae in *A. sirm*

Effect from the reproductive behavior of isopod parasites

A lesion associated with reproduction of parasites to the host is related to the direct activity of the parasites. A marked increase in the size of the parasite is associated with the development of marsupium full of juvenile parasite (Fig. 5). This can significantly be increased the pressure atrophy caused by the presence of the parasites. The marsupium of *Lironeca* is swollen with young, fills up most of the gill chamber and must diminish the flow of water through oxygen uptake in the parasitized gill chamber. The fish reaction is increased encapsulation, inflammation of those portions of the parasite that enter the fish (Ravichandran et al. 2000). The infestation of parasites is related to attachment feeding and reproductive activity of the parasite. The infestation usually pressure atrophy often accompanies the presence of larger parasites. They may lead to economic losses in commercial species of fish.

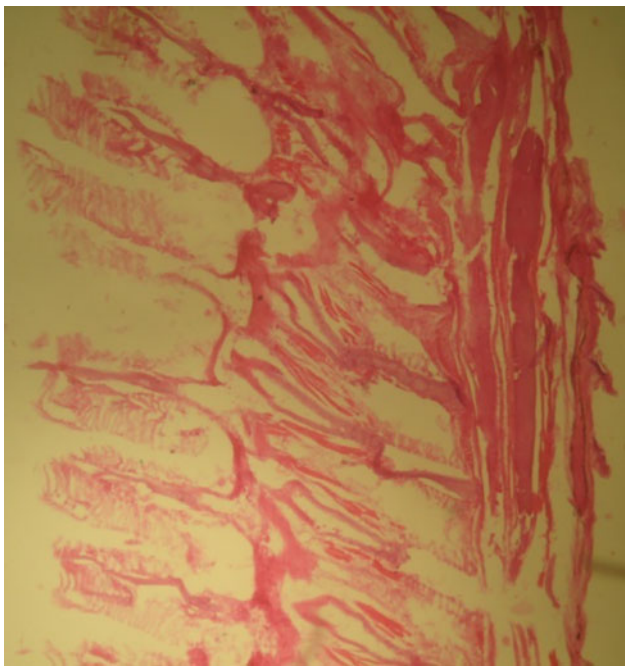

Fig. 3 Nature of thickening between the gill lamellae in *Amblygaster sirm*

Prevention and treatment of infections

Quarantine is the first defense (with close observation of new fishes), mechanical removal using forceps is sometimes

Fig. 5 Ready to release larvae (*left*) and adult ovigerous females (*right*)

possible, and osmotic shock (freshwater or saltwater dips) is sometimes effective, water treatments using organophosphates are sometimes warranted, diflubenzuron may also be effective. When considering treatments for isopod infections it is important to remember that some isopods can detach from and live away from their hosts for significant periods. Isopods can be mechanically removed from aquarium fishes and preserved in 10 % formalin or 70 % ethanol and stored in 70 % ethanol (151 proof rum will do) or 40 % isopropanol (rubbing alcohol). When confronting gnathiid infections it should be remembered that only the larvae are parasitic and that the adults may be found in the substrate. Thus, treating fishes infected with isopods without treating their environment may only provide temporary relief. It is also important to recognize the potential for secondary infections associated with severe isopod infections.

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