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Variation in the Morphological Features of Isopod Fish Parasites

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Abstract: Parasitic infestation is a cosmopolitan phenomenon in almost all the habitats, especially among the aquatic biota. Isopod parasites have received considerable scientific attention because they cause series damage to fishery resources. The parasitic fauna of fish represents the result of the interrelationship between the parasites of various developmental stages and many interdependent influences of the macro and micro-environment. The present paper provides a general introduction to the subject with special emphasis on the morphology, diversity and life cycle. The parasitation of isopod parasites leads to secondary infection by pathogenic microbes which may affect the fish population are also discussed.

Key words: Isopod parasites % Morphology % Diversity % Life cycle % Effect on host

INTRODUCTION

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. Isopods are primarily found in warm waters, they infect fish but also other crustaceans. Larval isopod parasites of the family Gnathiidae are abundant on the gills of tropical marine fish and represent a primary source of food for cleaner fish.

Parasitic isopods are typically marine and usually inhabit the warmer seas. Their body form (Fig.1) varies from an easily recognizable isopod to a relatively amorphous sac recognized 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 haemolymph. 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. Cymothoids are parasites of

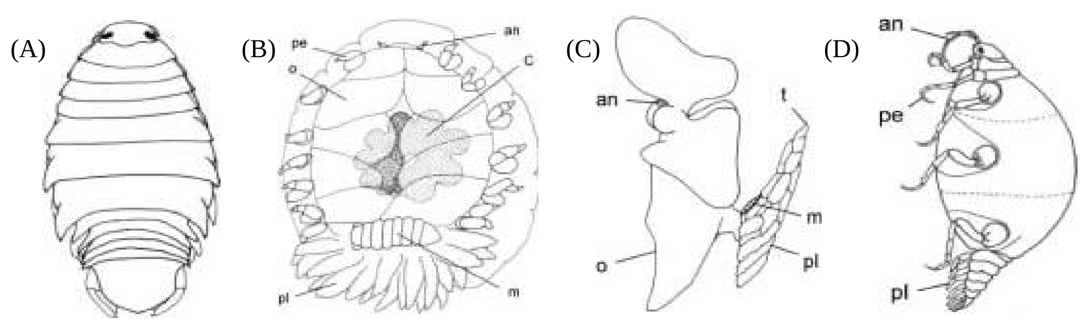

Fig. 1: Parasitic Isopoda – variation in body form of adult females. (A). A cymothoid, *Nerocila orbignyi*. (B). A bopyrid, *Epipenaeon ingens*, a parasite of prawns, itself parasitised by the cryptoniscid *Cabirops orbionei*. (C). An entoniscid, *Pinnotherion vermiforme* from within a pea crab, *Pinnotheres* sp., itself parasitising a mussel, *Modiolus modiolus*. (D). A gnathiid, *Paragnathia formica*. Abbreviations: an, antenna; C, cryptoniscid; m, male; o, oostegite; pe, pereopod; pl, pleopod; t, tip of abdomen. (Redrawn from [1]; drawn from unpublished photograph taken by L Owens; modified from [2]; modified from [3], respectively)

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Fig. 2: Male and Female *Joryma tartoor* in the branchial region

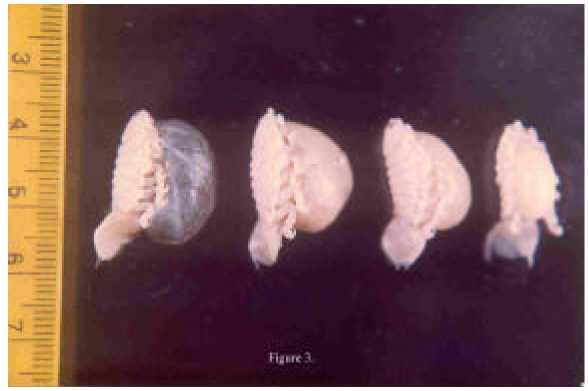

Fig. 3: Developmental stages of marsupium with manaca larva

fish, both as immature forms and adults. Epicaridians are parasites of Crustacea, 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 be closely related whereas the gnathiids appear to have evolved from a different isopod line.

Morphology and Diversity: These are the isopods commonly seen on teleosts in tropical and subtropical waters, attached to the body surface, in the mouth or on the gills [4,5]. 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 (Fig.2).

Though most adult isopods on fish belong to the Cymothoidae, there are parasitic forms in other families. The Aegidae, distinguished from Cymothoidae by having less modified pereopods, includes the notorious *Alitropus typus*, which parasitises fishes in India and south-east Asia in fresh and brackish waters. The parasites attack fish to feed but retain their free-swimming capability as adults. Unlike cymothoids they do not appear to be protandrous hermaphrodites. Tridentellid and corallanid isopods are mostly free living but have a few representatives that are parasites of fish, such as the corallanid *Argathona macronema* which is common in the nasal passages of serranids and lutjanids on the Great Barrier Reef. Some corallanids are parasitic on Crustacea. Those belonging to the genus, *Tachaea*, are parasites of freshwater shrimps in Asia and Australia and are usually found attached to the outside of the cephalothorax.

Life Cycle: Gravid females release eggs into a brood pouch or ‘marsupium’ formed from their ventral oostegites. Here the eggs embryonate, hatch and undergo two or more moults to form the ‘manca’ ‘pullus II’ stage. These are released from the brood pouch, sometimes more or less simultaneously as a result of contractions from the parent. The parent then moults, feeds, digests the meal and eventually produces the next batch of eggs. Several batches may be produced during her life span. The manacae have only six pairs of legs (compared to seven in juveniles and adults), large compound eyes and heavily setose pleopods with which they swim extremely rapidly (Fig.3). After a short free-swimming period they are parasitic and need to find a fish to take their first meal within one to two days or they will die. In genera such as *Anilocra* and *Nerocila* the mancae then leave the fish, moult, reattach to another fish and so on until they complete their juvenile moults, the number of which has not been determined for any species and approach adulthood. In other species such as the gill-inhabiting forms (e.g. *Mothocya*, some *Livoneca* sp.), the ‘tongue biters’ (e.g. *Ceratothoa* sp.) and the tissue dwellers (e.g. *Ourozeuktes* sp.) the mancae or an early juvenile stage move to the preferred site and remain attached to the fish.

Cymothoids are protandrous hermaphrodites. The first male to parasitise a fish changes into a female. Males attaching to the same fish remain as males. It seems likely that a pheromone or neurohormone is released by the female which inhibits further development of the males. Egg development apparently depends on the presence of a male, for each batch. Fertilizations occur immediately after the female has moulted in some species. In some skin-inhabiting forms males are rarely found. They presumably remain free-swimming and stay with females only long enough for fertilization to occur. In others the small males are permanently attached alongside females and have lost the ability to swim. In gill-inhabiting species such as *Enispa convexa*, non-swimming males are found on the same fish as females, though not necessarily in the same gill cavity and move back and forth to fertilise the females, presumably again in response to a female pheromone. In 'tongue biters' such as *Ceratothoa imbricata*, juveniles and one or more males occur on the gills and the adult female in the mouth. In tissue-inhabiting forms such as *Ourozeuktes*, small males are found in the pouch with the female. Male cymothoids are usually narrower than females and the ratio of length to width has been used as a measure of femininity, the Montalenti Index [6]. There is usually a strong correlation between parasite length and host length, in some cases because the fish are parasitised when small and the parasites live for many years and in other cases where the parasite apparently grows to fill the available space and then stops.

Effect on Hosts: Cymothoids harm the fish in several ways. Mancae feed voraciously and easily kill fry and fingerlings through the tissue damage they cause. Permanently attached adults stunt the growth of fish and retard or inhibit reproduction, probably because of the nutritional drain though more subtle mechanisms such as through hormonal changes have not been ruled out. Those in the gill chamber are usually associated with stunted gills, partly from pressure atrophy and partly from damage associated with feeding and attachment. They have also been frequently associated with anaemia. Those in the mouth affect the development of oral structures and may completely replace the tongue, as in *Ceratothoa oestroides*. Menhaden infested by the buccal parasite, *Olencira praegustator*, school separately from uninfested fish of the same age. The tissue-inhabiting forms such as *Ourozeuktes* sp., which form a pouch from a depression in the skin, cause pressure atrophy of adjacent muscle and visceral organs. Though cymothoids penetrate the skin with their pereopods and mouthparts and the tissue-inhabiting forms maintain a small opening to the outside, little secondary infection occurs. In Mediterranean mariculture, infections of *Nerocila orbignyi* on the gills of sea caged bass, *Dicentrarchus labrax* and bream, *Sparus aurata*, are associated with poor growth. The using fine mesh nets near aquaculture cages to keep out mullet believed to be the source of the parasite [7]. To avoid the parasite *Emetha audouini*, cages containing sea bass were moved away from the shore into deeper water with a stronger current [8]. Salmon farms in Chile and Australia have been plagued by tongue biters, *Ceratothoa* sp. In Chile the problem became less acute when the numbers of the normal host *Trachurus murphyi* declined.

The pathogenic microbes and parasite presence could damage the physiological and reproductive activities of the host fish, [9,10]. There by a regional difference for the proliferation of microbes was observed. The greater degree of vibrio count and THB in the branchial region could be due to the severity of lesion at this site as it was reported in the fish Creole parasitized by *Nerocila acumunata* [11]. Also the contamination of this area more frequently by the respiratory water current that carries bacteria along with food particles, could have enhanced bacterial invasion. The bacterial invasion in the branchial region reduces the respiratory area by clubbing and fusion of gill lamellae and affects respiration as well as nitrogenous wastes excretion [11-17]. The infestation such hyperaemia, haemorrhagic lesions and penetration of dactylus usually pressure atrophy, which often accompanies the presence of larger parasites. They may lead to severe economic loss in the commercial species of fishes.

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