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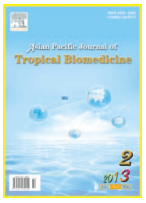

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Effect of the parasitic isopod, *Catoessa boscii* (Isopoda, Cymothoidae), a buccal cavity parasite of the marine fish, *Carangoides malabaricus*

Ganapathy Rameshkumar*, Samuthirapandian Ravichandran

Centre of Advanced Study in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai-608 502, Tamil Nadu, India

PEER REVIEW

Peer reviewer

Prof. Baha Latif, Faculty of Medicine, Universiti Teknologi MARA, 47000 Sungai Buloh, Selangor, Malaysia.
Tel: +6017 3145649
Fax: +603 55442831
E-mail: bahalatif@yahoo.com

Comments

The results of this study are very interesting and show the effect of the infestation of fishes with isopods parasites. The parasite did not cause the death of fishes, but it had significant effect on the weight of infested fishes. The work will assist the researches to plan for new preventive measures of fishes diseases.
(Details on Page 121)

ABSTRACT

Objective: To examine the effect of isopod parasite *Catoessa boscii* (*C. boscii*) on *Carangoides malabaricus* (*C. malabaricus*). **Methods:** The host fish *C. malabaricus* infested by *C. boscii* were collected directly from the trawlers landed at Parangipettai coast during December 2008 to November 2009. Data regarding the total length, width, weight and sex of the host fish were recorded. Effect of infestation on *C. malabaricus*, the length and weight data were analysed and host specificity of isopods was also examined. **Results:** During the sampling period, 585 *C. malabaricus* were examined. Among them, 218 specimens were found to carry 243 parasites. Three pairs of isopods (one male with one female) were recorded from the host fish and each pair was attached to the tongue in the buccal cavity of the host. Another pair was also found where the male and male, female and female isopod had settled on the tongue in the buccal cavity. Gross lesions observed in the buccal cavity of infested fish showed small pin-holes in the tongue region, through which dactyls of pereopod's penetrating claws dig into the host tissues. The maximum weight loss was reported in females (5.43%) than in males (3.75%) of *C. malabaricus*. Due to infestation of different isopod parasites in both male and female fish, the effects on the length-weight relationship of *C. malabaricus* were compared. The rate of increased growth in weight in uninfested female fish was found to be higher than that of the infested. The weight gain is faster in uninfested fish than in the infested fish. **Conclusions:** From the above mentioned observations, it is clear that the worst of fish on account of the infestation of isopods are the *C. malabaricus* succumbed to the attack of isopod parasites. Although, the infestation did not cause immediate death, it had affected the normal growth of the host fish.

KEYWORDS

Isopod parasites, *Catoessa boscii*, *Carangoides malabaricus*, Host specificity, Buccal cavity

1. Introduction

Most of the fish species are infested by cymothoid isopods whose position is on the host (buccal, gill, burrowing or external), and general body shape have long influenced interpretation of the relationships of cymothoid genera[1-3]. However, the Indian cymothoid fauna is still poorly known. Until now, accurate studies of these parasitic isopods which were scanty on Indian fishes have already been recorded by the researchers[4-6]. Probably all species of cymothoids are protandrous hermaphrodites, with the male larvae settling out of the plankton onto the mouth, body surface, body cavity, or gills of their host[7,8]. After a period of maturation, males of some species become associated with the buccal cavity where they undergo a sex change. The physiological effects of cymothoid infection are not clearly understood. Deleterious effects on host finfish have been reported in several studies citing tissue damage; host behavioral changes; decreases in mean weight, size, and growth; and in some instances, death[9,10].

Earlier researchers recognised it, and placed all the gill and buccal attaching genera in a single lineage[10]. Thus

*Corresponding author: Ganapathy Rameshkumar, Centre of Advanced Study in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai-608 502, Tamil Nadu, India.
Tel: +91-4144-243223, 243533
Fax: +91-4144-243555
E-mail: grkumarcas@gmail.com

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the recent discovery of cymothoides attached in the buccal cavity of lesser weever fish (*Echiichthys vipera*) in Whits and Bay, Cornwall, is unusual. Only four marine species of the cymothoid isopod genus *Catoessa* occur in the world, of these species *Catoessa scabricauda*, *Catoessa ambassae*, *Catoessa gruneri* and *Catoessa boscii* (*C. boscii*) are widely distributed. This isopod is a buccal parasite, but attaches to the lateral internal face of the buccal cavity, with the isopod dorsal surface medial[1]. *C. boscii* is predominantly distributed throughout the Parangipettai coast and occurs along the Indonesia[11]. *C. boscii* is most commonly found on fishes of *Carangoides malabaricus* (*C. malabaricus*) and not many studies on *C. boscii* were reported earlier in Indian waters.

2. Materials and methods

The host fish *C. malabaricus* infested by *C. boscii* were collected directly from the trawlers landed at Parangipettai coast during December 2008 to November 2009. Isopods were removed from the buccal cavities of the fish hosts and immediately placed into 70% ethanol. The total length of the fish hosts and isopods were measured and all measurements were in millimetres. Mouthparts and appendages were carefully dissected by using dissecting needles and forceps. Host nomenclature and fish taxonomy are according to Fish Base[12]. Data regarding the total length, width, weight and sex of host fish were recorded. To study the effect of infestation on the *C. malabaricus*, the length (mm) and weight (g) data were analysed. The total length of the fish was ranged from 80 to 180 mm and the weight ranged from 6.5 to 29.0 g. The fish were categorized as infested and uninfested and the average length and weight were determined. The loss of weight and percentage loss of weight of male and female fishes were determined. The feeding status of the isopods was confirmed by the presence/absence of a darkened and host specificity of isopods was also examined.

3. Results

3.1. Host specificity of isopod parasites

Host specificity is very strongly expressed in a great number of fish parasites, especially in the majority of ectoparasites like isopods. The exact location of the *C. boscii* was found to occur only in *C. malabaricus*, the site of infection in the buccal cavity of the parasite on a diagrammatic representation of the individual fish species. It is believed that the development of specificity in all those ectoparasites has been promoted by the combination of two factors: the uniformity of diet (blood or epithelium) and morphological adaptation to the particular kind of epithelium or scales. This position seemed to be very protective for the parasite from the force of the currents and from the host. Figure 1 shows that *C. boscii* invaded the buccal cavity of *C. malabaricus*.

Figure 1. *C. boscii* attached in the buccal cavity of *C. malabaricus*.

The site of attachment of the parasite, indicative of mucus and blood feeding were found at the time of observation. The parasites were normally seen protruding through the mouth opening of the host. Many cymothoids were found in the mouth and buccal cavity of the host fish, and their position was thus highly specific. The parasite was attached in such a way that the broader posterior part of the parasite was lodged in the wider portion of the floor of the buccal cavity and the narrow anterior part was either located towards the mouth opening or protruding out through the mouth.

In some fish, two *C. boscii* parasites were normally found, of which one was the large ovigerous female found in mouth and the other one was small and more active male observed in the buccal cavity. Most of the females of these species attached right-side up on the tongue of fishes. Only two parasites specifically attached up-side-down on the roof of the mouth of fishes. The studies have found that parasitic infection may reduced or interfere with the ability of the host to feed.

3.2. Effect on the buccal cavity

The parasites encountered in the buccal cavities occupied the floor of the lower jaw, and were attached firmly to the tongue with their heads oriented towards the interior of the host. Three pairs of isopods (one male with one female) were recorded from host fish and each pair was attached to the tongue in the buccal cavity of the host. Another pair was also found where the male and male, female and female isopod had settled on the tongue in the buccal cavity.

Gross lesions observed in the buccal cavity of infested fish showed small pin-holes in the tongue region, through which dactyls of pereopod's penetrating claws dig into the host tissues. The result was usually a localised destruction of the epidermis, and an inflammatory response around

the attachment area was noticed (Figure 2). After attaching themselves on the base of the tail fin or on the flank, the young isopods progressed to the anterior part of the body, going beneath the operculum and settling in the buccal cavity.

Figure 2. Pereopods of male and female *C. boscii* strongly attached inside the bucccal cavity.

There is a strong competition among the pulli seeking attachment in the mouth of the host. Only two pulli may settle in the buccal cavity of the host comprising the pair of future adults. Thus, although in the first phase of infection, a fish may be attacked and carried more than two pulli on its body surface and gill cavity, eventually no super-infection is possible and mostly two isopods may be hosted in the buccal cavity on any one fish.

During the sampling period, 585 *C. malabaricus* were examined. Among them, 218 specimens were found to carry 243 parasites. The effect of infestation on the loss of body weight was (2.28%) compared to parasited fish (Table 1). The maximum weight loss was reported in females (5.43%) than in males (3.75%) of *C. malabaricus*. The effects on the length-weight relationship of *C. malabaricus* due to infestation of different isopod parasites in both male and female fish were compared and the results are presented in Table 2.

Table 1
Effect of isopods in relation to the body weight of malabaricus fishes.

Nature of infestation	Mean body weight (g)	Reduction of weight (g)	Reduction of weight (%)
Uninfected	22.60	4.56	-
Infected	17.64	4.96	2.28

Table 2
Percentage weight variation in male and female of Carangid fishes.

Weight (g)	Sex of host	Uninfected	Infected
Mean weight	Male	21.67	17.40
	Female	23.54	17.89
Loss of weight	Male	-	4.27
	Female	-	5.65
Percentage loss of weight	Male	-	3.75
	Female	-	5.43

The rate of increased growth in weight of the uninfested female fish was found to be higher than that of the infested. The inference was that the weight gain was faster in the uninfested fish than in the infested fish (Table 2).

4. Discussion

Parasitic crustaceans are the largest fish parasites, which cause considerable damage to their hosts. Isopods inhabiting the buccal cavity and branchial chamber inflict damage to gill through attachment and feeding and that the extent of damage is directly proportional to the size of the parasite and duration of settlement. The findings of the present investigation indicate that infestation causes serious problem to host animals either directly or indirectly affecting the physiological status of host.

Loss of weight has been probably the most common effects on crustacean infestation. The present study also revealed that there was significant weight loss in the infested *C. malabaricus* thereby showing the fact that infestation caused weight loss in fishes. The parasitized fish did not show any obvious signs of harmful effects caused by *Cymothoa spinipalpa*[13]. No significant differences were found between parasitized and nonparasitized fish in relation to their condition factor. But the findings of the present investigation were contradictory to earlier works. Parasitised fishes were significantly shorter and thinner than unparasitised fishes of the same age[14]. Fish parasitised by a cymothoid was shorter than unparasitised fish of the same year class and had significantly reduced growth rates[15]. In the present study of parasitised host fish, the body weight was found to be reduced. The loss of weight can be attributed to more than one cause and the most obvious one is the loss of food reserves drawn from the various depots and other tissues to help in coping with the range of infestation[16-18].

A number of cymothoids, including *Nerocila orbignyi* and *Nerocila bivittata* are specific in their choice of hosts, whereas other genera are less specific[19]. The results of this investigation indicate that *Nerocila phaeopleura*, although comparatively primitive in being an external parasite and being highly host specific, is also highly specialized to a mode of life upon a pelagic, fast swimming host. It lives on a highly specific region of the body. This position is determined by the needs of the parasite and the limitations exerted by the morphology and habits of the host.

The decreasing prevalence at larger host sizes that observed is consistent with other reports of infection on larger juveniles and offshore adults[10]. *Cymothoa spinipalpa* and *Rocinela signata* showed a higher prevalence in hosts with a longer-body size, especially for individuals between 15 and 30 cm length[20]. A low prevalence of 14% and a new occurrence of isopod *Cymothoa* sp. have been found in

Seagara Anakan Lagoon, Indonesia[21]. The size of fishes that can be infested will be within certain maximum-minimum variables depending upon the species of host[9]. Specific physical properties of the estuaries could favour broader spreading of the isopods, so that fish infestation was generally higher[10].

Main factors determining the fish parasite fauna as well as intensity and prevalence of infestation in marine environments[22]. Significantly showed that a number of cymothoids, including *Nerocila orbignyi* (Guerin) and *Nerocila bivittata* (Risso) are specific in their choice of hosts, whereas other genera are less specific[19]. *Nerocila phaeopleura*, is being host specific, would thus seem to fit in with an apparently generic characteristic and it seems reasonable to assume that *Sardinella gibbosa* is the major host of this species in the South China sea.

Parasites can infect larval, juvenile or adult marine fishes; however, the effects of parasites on the growth and condition of fish larvae have seldom been investigated[23]. The dorsal surface of the parasite is always in close contact with the first gill arch, causing more atrophy of the first gill filament. The effects are usually localised pressure atrophy often accompanied by the presence of larger parasites[24]. Although coral reef fishes are known to be affected by cymothoid isopod ectoparasites[25,26], and to exhibit lateralization in turning direction[27], the effects of parasitism on lateralization behavior has never been studied. In this study, we calculated the rate of increased growth in weight in uninfested female fish was found to be higher than that of the infested. The inference is that the weight gain is faster in uninfested fish than in the infested fish.

The site of attachment of *C. boscii* in *C. malabaricus* the brushlike pads on the roof of the buccal cavity, renders much protection to the parasite. The threat of being washed into oesophagus with the incoming water current, which parasites of the buccal cavity have overcome by resorting to firm attachement to the host tissue. *C. boscii*, although comparatively primitive in being a buccal parasite and being highly host specific is also highly specialised to a mode of life upon a pelagic, fast swimming host. It lives on a highly specific region of the body. This position is determined by the needs of the parasite and the limitations exerted by the morphology and habits of the host. However, our data indicate that infection by *C. boscii* had little effect on the mass of *C. malabaricus* stomach contents. While infected bluefish may weigh slightly less for a given length, infection does not appear to impair feeding. From the above mentioned observations, it is clear that the worst of fish on account of the infestation of isopods are the *C. malabaricus* succumbed to the attack of isopod parasites. Although, the infestation did not cause immediate death, it had affected the normal growth of the host fishes.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

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Comments

Background

C. boscii is considered one of the most isopod parasites that infest *C. malabaricus* fishes. It causes damage to the buccal cavity and gills. These parasites elicit severe destruction of the infested areas which characterized by inflammation around the attachment area and this ultimately will effect on the physiological status of the host. Although the parasite dose not lead to the death of the host but it still cause weight loss and this is important in fishes industry.

Research frontiers

The study was conducted to determine the effect of isopod parasite *C. boscii* on *C. malabaricus*. The results showed at least three pairs of isopods were found in the buccal cavity of fish and the infestation caused loss of weight of infested fishes.

Related reports

The results of the study are not in agreement with previous studies in regard to the length and width of infested fishes Adlard and Lester and Fogelman *et al*. The current study showed the body weight was reduced.

Innovations and breakthroughs

The data of this study showed the significant effect of infestation of *C. boscii* on the *C. malabaricus*. The weight loss in female fishes was more than in males. Also the weight gain is faster in uninfested fishes in comparison with infested fishes.

Applications

The data of this study is very important in fishes industry and indicate the economical losses due to the infestation with these parasites. Control measures are necessary to decrease the weight loss of infested fishes.

Peer review

The results of this study are very interesting and show the effect of the infestation of fishes with isopods parasites. The parasite did not cause the death of fishes, but it had significant effect on the weight of infested fishes. The work will assist the researchers to plan for new preventive measures of fishes diseases.

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