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PERULERNAEA GAMITANAE (CRUSTACEA: LERNAEIDAE) PARASITIZING *COLOSSOMA MACROPOMUM* (OSTEICHTHYES: SERRASALMINAE) RAISED IN CAPTIVITY IN THE BRAZILIAN AMAZON

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ABSTRACT

It was studied the parasitism of *Perulernaea gamitanae* in *Colossoma macropomum* raised in earthen ponds in the city of Benjamin Constant, State of Amazonas, northern Brazil. It was examined 40 fish – weight 1.258 ± 0.33 kg, size 40.64± 3.23 cm – and found 225 individuals of *P. gamitanae* parasitizing *C. macropomum* on the tongue (117), nasal cavities (3), gills and internal opercle surface (105). Prevalence was 100%, intensity was 3-14, and the average intensity and abundance were both 6.15 ± 2.14.

Key words: fish parasites, Cyclopoida, Copepoda, Solimões River, fish farming, Amazônia.

RESUMO

Foi estudado o parasitismo de *Perulernaea gamitanae* em *Colossoma macropomum* criados em viveiros escavados no município de Benjamin Constant, Estado do Amazonas. Foram examinados 40 peixes – peso 1.258 ± 0,33 kg, tamanho 40.64 ± 3.23 cm – e encontrados 225 indivíduos de *P. gamitanae* parasitando *C. macropomum* na língua (117), fossas nasais (3), brânquias e a superfície interna do opérculo (105). A prevalência foi 100%, a intensidade foi 3-14, a intensidade média e a abundância foram ambas 6.15 ± 2.14.

Palavras-chave: parasitas de peixes, Cyclopoida, Copepoda, rio Solimões, criação de peixes, Amazônia.

INTRODUCTION

The rise of an intensive and semi-intensive rearing of fish in the Brazilian Amazonian region motivated the increase of studies for control and treatment of many fish diseases (Morais, 2009). Among the health problems that affect fish reared in captivity, parasitism is a very worrying one, because factors related to fish management may break the host-symbionts balance, resulting in epizooties difficult to control (Malta *et al.*, 2001).

Many organisms parasitize freshwater fish, like crustaceans, isopods and copepods (Malta & Varella, 2000; Benetton & Malta, 1999). Among the copepods, the lernaeid *Perulernaea gamitanae* Thatcher & Paredes, 1985, has a great parasitological importance, because it is one of the Amazonian species that parasitize the tambaqui *C. macropomum*, and may even kill this fish when they are reared in captivity

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(Thatcher & Williams, 1998).

As the tambaqui is one of the most economically important fish species throughout the Amazonian region, we conducted the present study in order to contribute to the knowledge of fish parasitism.

MATERIAL AND METHODS

Fish acquisition and first transportation**:** The tambaqui fingerlings were obtained through induced spawning in the fish culture station of the Hydroelectric of Balbina (01º52'S, 59º28'W), Amazonas State, northern Brazil. In October 2004 it was obtained fingerlings with 30 days life, size 1-2 cm, and kept in sealed plastic bags, with one part of water and three parts of oxygen. From the hydroelectric the fingerlings were transported to Manaus (03º08'S, 60º01'W), nearly 200 km from Balbina.

Second transportation**:** After the fingerlings acquisition and the transportation to Manaus, the fish were transported from Manaus to the city of Tabatinga (05º47'S, 65º24'W), Brazilian Amazonia in the upper course of the Negro River, where they were stocked in earthen tanks during one month.

Third transportation**:** The fingerlings grew up to 5cm in the first place where they were stocked and then they were transported to the fish culture station at the city of Benjamin Constant (04º 24'S, 70º 02' W), also in the Brazilian Amazonia.

Fourth transportation**:** On May 2005 the fish weighed 30g and were redistributed to two fish farmers in the city of Benjamin Constant: the Sete Irmãos and the Aldrim farmers. However, only in the former the fish had parasites, reported here.

The intermediate and permanent earthen ponds**:** The Sete Irmãos fish farm received 4,700 *C. macropomum* juveniles, placed in one of the eight earthen ponds with 0.7 ha in size, at a density of 5.2 fish per square meter. After 30 days, the fish weighed 150g and were transferred to a second pond with 0.8 ha in size, at a density of 5 fish per square meter. The fish were fed with extruded food containing 35% of net protein (NP).

Field epizooty observations**:** In May 2006 the tambaqui fish were 1 year and 6 months old, when the epizooty was first recorded. At this time a sample of 40 fish was removed with gill nets and each individual was examined looking for parasites.

Laboratory parasite observations and other procedures**:** The fish were weighed (g), measured (standard, furcal and total length - cm) and numbered before death through brain puncture. Body surface, fin bases, nasal cavities, oral and gill cavities, tongue and anus were searched for ectoparasites. The parasites found were removed with tweezers and knife, fixed and preserved in 70% alcohol.

Sample and inferences**:** 40 fish – weigh 1.258 ± 0,33 kg, size 40.64 ± 3.23 cm – were examined. The parasite indexes were calculated according to Bush *et al*. (1997). The number of fish from the parasitological sample was calculated according to the *American Fisheries Society* table, modified by Kabata (1985), with a 95% degree of confidence and prevalence estimated at 10%.

RESULTS

We recorded 225 *P. gamitanae* individuals parasitizing the first gill arch (19), the third (2) and the gill rakers (9). Other organs were also parasitized, such as the nasal cavities (3), the inner gill surface (75) and the tongue (117).

The gills showed hyperplasia and anemia. The internal portion of the opercle and the nasal cavities had hemorrhagic processes near the fixation spots. Intense hemorrhage occurred when the parasites were removed from the fish's tissues.

It was also observed strong inflammatory reaction, with red and darkened lesions, all over the parasitized portions of the fish, especially in the tong, where drillings could be clearly observed, but with no parasites.

The parasite indices of *P. gamitanae* on the 40 *C. macropomum* individuals were: prevalence 100%, mean intensity (range 3-14) and mean abundance were

both 6.15 ± 2.14 parasites on the host. No other parasite species was observed on the fish; therefore mean intensity and mean abundance could only be the same in this case (Margolis *et al*., 1982).

Other ponds of the farm had the pirarucu *Arapaima gigas* (Shinz, 1822) and the matrinxã *Brycon amazonicus* (Spix & Agassiz, 1829) collected in nature, however, only *C. macropomum* was parasitized by *P. gamitanae*.

DISCUSSION

Some factors addressed in this study are relevant for brief discussions, such as the importance of the fish and parasitism on the species, some taxonomic characteristics of the parasite, specificity of the parasite to the host, parasitized organs with tissue inflammation, and indices of parasitism on the studied fish.

The fish in this study context

Because of the economic importance of the tambaqui *C. macropomum* we conducted the present study related to parasitism. This fish is widely distributed in the main South American northern rivers, where individuals may reach 1 meter long and 30 kg (Araujo-Lima & Goulding, 1998). The body proportions of this fish and its good meet led him to be one of the first species in the Amazon region with sufficient knowledge to enable plans for natural stocks management and rearing. However, one problem related to this is that the tambaqui is seriously attacked by parasites when reared in captivity.

Parasitism in Colossoma macropomum (Cuvier, 1818)

Among the organisms that parasitize freshwater fish, the crustaceans, isopods and copepods are the most frequent. *Colossoma macropomum*, for example, is parasitized by six crustacean species – five from the class Branchiura: *Dolops carvalhoi* Lemos de Castro, 1949 (Malta & Varella, 1983); *D. geayi* (Bouvier, 1892); *Argulus multicolor* Stekhoven, 1937 (Malta, 1983); *A. chicomendesi* Malta & Varella, 2000 (Malta & Varella, 2000) and one unidentified form of the genus *Argulus* (Malta, 1884).

Also, *C. macropomum* is parasitized by one Isopoda species, *Braga patagonica* Schiödte & Meinert, 1884, and three Copepoda species, namely *Gamidactylus jaraquensis* Thatcher & Boeger, 1984 (Fischer *et al.* 2003), one unidentified species from genus *Miracetyma* (Malta, 1993) and *Perulernaea gamitanae* (Fischer *et al*, 2003; Benetton & Malta, 1999).

Taxonomic characteristics of Perulernaea gamitanae

This copepod species is endemic to the Neotropical region and seems to be specific to *C. macropomum*. The species is characterized by round head anchors in the post-metamorphic females, thin neck, posterior region of body fusiform and few post-equatorial pores, uropods, four pairs of well separated legs and multiseriate egg sacks (Thatcher & Paredes, 1985; Benetton & Malta, 1999).

The naupliar stages are free-living and the time of development from nauplius I to VI is around 5 days. In the copepodite stage I it is necessary a host to continue the life cycle. The free-living stage I copepodite survived seven days with no ecdysis.

Parasite specificity

The first record of *P. gamitanae* parasitizing *C. macropomum* in captivity was reported by Benetton & Malta (1999). They collected adults reared in earthen ponds in the Aquiculture Station of the Instituto Nacional de Pesquisas da Amazônia, in Manaus.

The literature reports no *P. gamitanae* infestation in a sample of 435 fish of four orders and 44 species from the rivers Guaporé, Mamoré, Pacaás-Novos, Jamari, Jiparaná and Urupá, in the State of Rondônia, southeast Brazilian Amazon (Malta, 1993a;

1993b; 1993c; 1993d; 1993e; 1994a; 1994b; Malta & Varella, 1996; Varella & Malta, 1995; 2001).

However, in a sample of 1,355 fish of five orders and 80 species from Lake Janauacá, Solimões River, in the Central Amazon Basin, Malta (1984) and Malta & Varella (1983) reported that *P. gamitanae* was found specifically parasitizing *C. macropomum*, while no other fish species was observed parasitized by this copepod in their studies.

Organs affected by the infestation of* P. gamitanae *and tissue inflammation

Although the fish conditions of this present study, such as the induced spawning, captivity, and size (36.0 cm – 44.5 cm), an expressive number of *P. gamitanae* was observed parasitizing *P. macropomum* – 225 parasites in 40 examined fish. The most parasitized portion of the body was the oral cavity, with 117 parasites in the tongue and 3 in the nasal cavities.

In other studies cited in the current literature, Fischer *et al.* (2003) reported 51 *P. gamitanae* specimens parasitizing the oral cavity of five tambaqui fish and the nasal cavities in 69 collected tambaqui in the Amazon Basin. In the oral cavity they anchored to the dentary bone, tongue, esophagus wall, inner and outer surfaces of the opercle.

We observed that the tissue inflammation caused by *P. gamitanae* was red and darkened. The gills presented a process of hyperplasia and anemia. We found evident hemorrhagic processes close to the fixation spots in the internal region of the opercle and nasal cavities. When *P. gamitanae* individuals were removed from tambaqui tissues, intense hemorrhages occurred.

The strong inflammatory reaction, with red and darkened lesions in the portions of the fish found parasitized, were caused by the fixation spots of *P. gamitanae*. The severe inflammatory process observed in the tongue was caused by the penetration of the parasite's head, which was inserted nearly three centimeters inside the muscle. The deep perforations observed on the tongue were probably caused by previous lernaeids parasites and their respective fixation spots.

***Indices of parasitism in* C. macropomum**

The prevalence we observed in this study was 100%, intensity ranged from 3 to 14 parasites per fish; mean intensity and abundance were both 6.15 ± 2.14, considered very high, probably due to the fact that fish reared in captivity are concentrated in small areas. Also, *P. gamitanae* has a direct life cycle and no natural predators, which optimize the life cycle of the parasite.

Eight out of 36 *C. macropomum* fish from the Upper Solimões River, examined by Fischer *et al.* (2003), were parasitized by *P. gamitanae*, less then we report here. They found and discussed that: i) prevalence was 22.2%, mean intensity 2.5, intensity varied between 1 and 6, and abundance was 0.5 lernaeid per tambaqui, ii) 15 out 33 fish in another sample reported by Fisher and his colleagues from the Lower Amazon River were parasitized by *P. gamitanae*, iii) in this case, prevalence was 45.4%, average intensity 1.5, intensity 1 to 3, and abundance was 0.7 lernaeid per tambaqui.

Bastos *et al.* (1996) reported a sample of 30 *C. macropomum* from a fish farm in Bom Jesus de Itabapoana, Rio de Janeiro State. In 20 fish they found no parasites; in 10 juveniles 4-20 months old, 7 were parasitized by no more than 3 lernaeids. The parasite species reported by Bastos and his colleagues was the copepod *Lernaea cyprinacea* Linnaeus, 1758, an exotic species introduced to Brazil in 1988, belonging to the same Lernaeidae family of *P. gamitanae*. The authors reported that *L. cyprinacea* was found in fins and in its respective insertion bases in the body; the parasite indexes were very low, prevalence 20%, and intensity of 1 to 3 parasites per fish.

Benetton & Malta (1999) reported that *P. gamitanae* collected in tambaqui at Inpa's Aquiculture Station in Manaus, was found parasitizing the oral, gill and nasal cavities of the fish; prevalence was 95%. These results are so close to those found in this

present study and we conclude corroborating with other studies (e.g. Malta, 1983; Malta & Varella, 1983) that establish *P. gamitanae* as a specific parasite to *P. macropomum*.

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