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Parasites of four ornamental fish from the Chumucuí River (Bragança, Pará, Brazil)

Parasitas de quatro peixes ornamentais do Rio Chumucuí (Bragança-Pará, Brasil)

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Abstract

The objective of the present study was to evaluate the parasite fauna of four species of ornamental fish collected in the Chumucuí River, municipality of Bragança, Pará, Brazil. From June 2006 to December 2007. Fishes (n=307) belonging to four species were collected, including 23 specimens of *Moenkhausia sanctaefilomenae* (redeye tetra), 37 *Carnegiella strigata* (marbled hatchetfish), 7 *Chilodus punctatus* (spotted headstander), and 240 *Astyanax bimaculatus* (twospot astyanax). The parasites found belonged to three taxa: monogeneans in the gills, nematodes (larvae of *Capillaria* sp. and *Contracaecum* sp.) in the digestive tract and liver and acanthocephalans (*Quadrigyrus torquatus*, *Q. brasiliensis* and *Q. nickoli*) in the stomach and intestine. *Astyanax bimaculatus* presented higher prevalence of acanthocephalans in the wet season, and lower prevalence of nematodes in the dry season. The possible importance of these parasites in the exportation of ornamental fish is discussed.

Keywords: Amazon, ornamental fish, parasite, acanthocephalans, monogeneans, nematodes.

Resumo

O objetivo do presente trabalho foi avaliar a fauna parasitária de quatro espécies de peixes ornamentais capturados no rio Chumucuí, no município de Bragança-PA. Foram coletados um total de 307 peixes pertencentes a 4 espécies, sendo elas: *Moenkhausia sanctaefilomenae* (olho de fogo, n = 23), *Carnegiella strigata* (borboleta, n = 37), *Chilodus punctatus* (cabeça-para-baixo, n = 7) e *Astyanax bimaculatus* (lambari, n = 240) coletados de junho de 2006 a dezembro de 2007. Foram observados 3 taxa parasitando os peixes: monogenéticos nas brânquias, nematóides (larvas de *Capillaria* sp. e *Contracaecum* sp.) no trato digestório e fígado e acantocéfalos (*Quadrigyrus torquatus*, *Q. brasiliensis e Q. nickoli*) no estômago e intestino. *Astyanax bimaculatus* apresentou maior prevalência de acantocéfalos na estação chuvosa, menor prevalência de nematóides na estação seca. Discute-se a eventual importância destes parasitas na exportação de peixes ornamentais.

Palavras-chave: Amazônia, peixes ornamentais, parasita, acantocéfalos, monogenéticos, nematóides.

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Introduction

The Amazon River basin is a hydrographical complex composed of a large number of rivers, lakes and small tributaries, containing great animal diversity. Within this area, fish are the most important resource for the local economy (MATOS et al., 2004).

The ornamental fishery is a major activity in that region and constitutes an important economic resource, since these fish are exported to other countries in large quantities (CHAO, 2001). The state of Pará is the second most important state regarding exportation of ornamental fish in Brazil, and the region of Bragança is an important place for catching fish because of the high number of different ornamental fish species. At least 38 different species have been reported in that region (Silva, unpublished data; Paula, unpublished data). This is especially evident in the Chumucuí River, a tributary of the Caeté River, where Characiform fish (which comprise a large number of ornamental species) represent 49% of the most important fish species (Silva, unpublished data).

It is well known that exportation of ornamental fish may represent a gateway for both ecto and endoparasites to enter a new environment. Their introduction may have serious effects, especially when parasites come into contact with new host fish. Several cases of introduced parasites, sometimes with devastating consequences, can be found in the literature (KIM et al., 2002; MORAVEC et al., 1999; EVANS; LESTER, 2001), and the pathology of parasites in ornamental fish has been described in a number of studies (FERRAZ; SOMMERVILLE, 1998; PIAZZA et al. 2006; THILAKARATNE et al., 2003; PRANG, 2007; MOUTON et al., 2001; GARCIA et al., 2009).

In this paper, ecto and endoparasites of some species of economically important ornamental fish species from the Chumucuí River were studied: *Carnegiella strigata* (Günther, 1864) (Gasteropelecidae), commonly named "marbled hatchetfish"; *Moenkhausia sanctaefilomenae* (Steindachner, 1907) (Characidae), "redeye tetra"; *Chilodus punctatus* (Müller & Troschel, 1844) (Chilodontidae), "spotted headstander"; and *Astyanax bimaculatus* (Linnaeus, 1758) (Characidae), commonly known as "two-spot lambari" or "matupiri" in the Amazon region, and as "piaba" in the north of the country. It is important to mention that the parasites of these fish species have never previously been studied in this region.

Materials and Methods

Fish samples were collected twice a month (at the beginning and end of the month) from the Chumucuí River, a tributary of the Caeté River, in Bragança, Pará (1° 12' 38.3" S and 46° 47' 32" W). Monthly sampling was done from June 2006 to December 2007. The fish were transported alive in Styrofoam boxes to the laboratory, where they were sacrificed using the anesthetic benzocaine. They were then measured (total and standard lengths) and weighed. Parasites were collected and processed as described by Eiras et al. (2006), and were identified at the lower taxonomic level in accordance with Thatcher (2006) and Travassos et al. (1928). The parasitological indexes were calculated as recommended by Bush et al. (1997).

The water pH and dissolved oxygen were recorded at the time of sampling. Environmental data (rainfall and temperature) were obtained from the Meteorological Station of Tracuateua, which belongs to the Brazilian National Institute of Meteorology.

The parasitological indexes were correlated with the weight, total length and standard length of the fish, and with the oxygen, pH, temperature and rainfall, by means of Pearson's correlation test. The variance of the mean values of prevalence and intensity of infection for the dry and wet seasons was analyzed and compared using the t test (P = 0.05). Statistical tests were done using the Biostat 4.0 software.

Results

Four species of ornamental fish were collected from the Chumucuí River: *Moenkhausia sanctaefilomenae*, *Carnegiella strigata*, *Chilodus punctatus* and *Astyanax bimaculatus.* The number of specimens, number of infected specimens, prevalence, total and standard lengths (cm) and total weight (g) are shown in Table 1. *Moenkhausia sanctaefilomenae* and *A. bimaculatus* presented the highest percentage prevalence; *C. punctatus* showed an intermediate percentage and *C. strigata* presented the lowest percentage prevalence, compared with the other species (Table 1).

The observations on the parasites showed that they belonged to three different taxa: nematodes (larvae of *Contracaecum* sp. and *Capillaria* sp.); acanthocephalans (*Quadrigyrus torquatus*, Van Cleave, 1920; *Q. nickoli*, Schmidt and Hugghins, 1973; *Q. brasiliensis*, Machado, 1941); and unidentified monogeneans. The distribution of the parasites according to the hosts is indicated in Table 2.

The infection by monogeneans was not related to the length of the host. However, *Moenkhausia sanctaefilomenae* showed the highest values for prevalence and mean intensity of infection by monogeneans (17.3% and 5.0 ± 2.2, respectively). *Astyanax bimaculatus* presented lower prevalence (2.08%) and similar mean intensity of infection (5.3 ± 0.6), compared with *M. sanctaefilomenae.* On the other hand, *C. strigata* showed lower prevalence (2.7%)

Table 1. Number of fish collected from Chumucuí River, number of infected fish, prevalence (%) of the infection, total length in cm, standard length in cm, and total weight in g.

	Fish collected	Infected fish	Prevalence (%)	Total length (cm)	Standard length (cm)	Total weight (g)
Carnegiella strigata	37	9	24.3	3.5 ± 0.53	2.8 ± 0.36	0.56 ± 0.31
Moenkhausia sanctaefilomenae	23	20	86.9	4.6 ± 1.4	3.9 ± 1.03	2.37 ± 1.9
Chilodus punctatus	7	5	71.4	3.6 ± 1.18	4.8 ± 1.06	2.62 ± 1.49
Astyanax bimaculatus	240	199	82.9	4.4 ± 1.06	3.6 ± 0.95	1.66 ± 1.47

and lower intensity of infection (1.0 ± 0.16). Monogeneans were not observed in *C. punctatus*.

Nematodes were found only as larval stages in different organs of the fish (Tables 3 and 4). *Astyanax bimaculatus* was the most parasitized species, and the highest level of nematode prevalence (50%) was in the stomach. *Chilodus punctatus* showed the highest mean intensity among the four fish species (12 ± 0.3). Larvae of *Contracaecum* sp. and *Capillaria* sp. were only found parasitizing the intestine and liver of *M. sanctaefilomenae.*

Concerning acanthocephalans, only cystacanth stages of *Quadrigyrus* spp. were found in the stomach and intestine. Only two host species presented larvae of *Quadrigyrus* sp. in the stomach: *C. punctatus* (prevalence 25%; mean intensity of infection 1.5 ± 0.74) and *A. bimaculatus* (10.8%; 1.76 ± 0.63). *Q. torquatus* and *Q. nickoli* were observed in *A. bimaculatus*; *Q. brasiliensis*, *Q. torquatus* and *Q. nickoli* were observed in *M. sanctaefilomenae*; and unidentified acanthocephalans were seen to be parasitizing *C. punctatus*.

The relationship between abiotic and biotic factors (Figure 1) showed that the only significant correlation with infection due to acanthocephalans was in the anterior intestine of *A. bimaculatus*, with higher prevalence in the wet season ($P < 0.05$). In the same host, the prevalence of nematodes in the anterior intestine was also significantly higher in the dry season ($P < 0.05$).

Table 2. Distribution of the parasites according to fish species.

Fish species	Parasites
A. bimaculatus	*Q. torquatus, Q. nickoli*, unidentified monogeneans and nematodes
M. sanctaefilomenae	*Contracaecum* sp., *Capillaria* sp. *Q. torquatus*, *Q. nickoli*, *Q. brasiliensis* and unidentified monogeneans
C. punctatus	Unidentified nematodes and acanthocephalans
C. strigata	Unidentified monogeneans and nematodes

Discussion

The results showed that parasites belonging at least to three different taxa were present in the ornamental fish caught from the Chumucuí River. Similar results, sometimes with higher diversity of parasites, have been found in other ornamental fish species (PIAZZA et al., 2006; TAVARES-DIAS et al., 2009, 2010).

Table 3. Prevalence (%) of nematodes in the organs of the different fish species. Stomach; Anterior intestine; Middle intestine; Posterior intestine; Liver; Pyloric cecae; Total prevalence.

	Stomach	Anterior intestine	Middle intestine	Posterior intestine	Liver	Pyloric cecae	Total prevalence (%)
A. bimaculatus	49.1	27.91	12.0	34.7	36.25	9.1	82.9
M. sanctaefilomenae	39.13	34.78	13.0	34.78	34.7	27.7	86.9
C. punctatus	50	37.5	0	1	50	0	71.9
C. strigata	5.4	13.5	0	0	2.7	0	24.3

Table 4. Mean intensity (parasite/fish infected) of infection and standard deviation according to the nematodes in the organs of the different fish species. Stomach; Anterior intestine; Medium intestine; Posterior intestine; Liver; Pyloric cecae.

	Stomach	Anterior intestine	Middle intestine	Posterior intestine	Liver	Pyloric cecae
A. bimaculatus	6.7 ± 7.4	4.49 ± 3.04	4 ± 1.9	10.41 ± 1.83	9.17 ± 7.89	3.1 ± 1.3
M. sanctaefilomenae	6.44 ± 4.91	3.55 ± 2.6	2 ± 0.75	4.5 ± 3.69	4.5 ± 3.38	8 ± 4.7
C. punctatus	5.75 ± 3.13	5.6 ± 3.8	0	12 ± 0.3	10.7 ± 3.1	0
C. strigata	2 ± 0.4	1.2 ± 0.4	0	0	4 ± 0.6	0

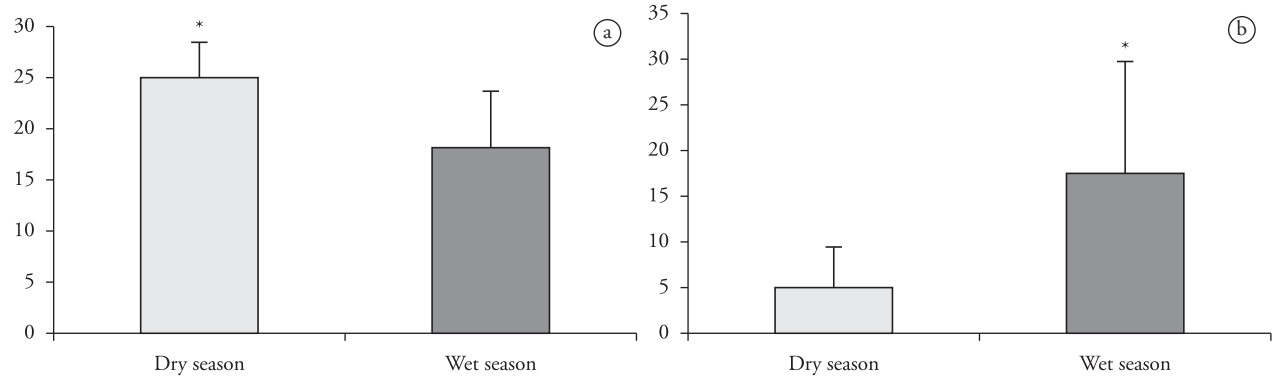

Figure 1. Prevalence of parasites in the anterior intestine of the fish *Astyanax bimaculatus*, according to dry and wet seasons. a) nematode; b) acanthocephalan.

Moenkhausia sanctaefilomenae is a new host for *Contracaecum* sp., *Capillaria* sp., *Q. torquatus*, *Q. nickoli* and *Q. brasiliensis*, and *A. bimaculatus* is a new host for *Q. torquatus* and *Q. nickoli*.

The monogeneans are mostly ectoparasites and are frequently observed in the gills. They are especially important in relation to fish rearing and may cause high mortality rates among farmed fish (FUJIMOTO et al., 2010). In these specimens, the intensity of infection was not related to the size of the hosts, contrary to what was observed by Pereira Junior et al. (2002) and Gonzáles et al. (2001) in relation to *Neoheterobothrium* parasitizing *Hippoglossina macrops*, which was related to greater surface area of the gills of the older hosts.

Larvae of the nematode species, *Contracaecum* sp. and *Capillaria* sp., were observed parasitizing *M. sanctaefilomenae*. According to Dick and Choudhury (1995), the larvae may be more dangerous than the adults given that they can migrate through the fish to several target organs. *Astyanax bimaculatus* was the most infected fish species, presenting prevalence of 82%. It is interesting to note that for the same host species captured at Lages (state of Rio de Janeiro), Paraguassú and Luque (2007) reported prevalence of 41% for two nematode species, and in *A. fasciatus* they found prevalence of 39.2% for three nematode species. Also, Martins et al. (2005) found *Contracaecum* sp. infecting 100% of *Hoplias malabaricus* and 80% of *Hoplyerythrinus unitaeniatus* caught in the state of Maranhão, and Barros et al. (2007) observed prevalence of 73% in *H. malabaricus* caught in the state of Mato Grosso. In the present study, the prevalence of nematodes in the anterior intestine was significantly higher in the dry season. However, the results of Martins et al. (2002) showed greater numbers of nematodes in the wet season in the Volta Grande region, state of Minas Gerais. According to Yamamoto et al. (2004), the alternation of wet and dry seasons and the consequent pronounced variation in the water level of the river could influence the food resources of the fish and indirectly influence the number of nematodes, due to variable predation on their intermediate hosts.

The acanthocephalans (*Q. torquatus*, *Q. nickoli* and *Q. brasiliensis*) were found in *A. bimaculatus*, *M. sanctaefilomenae* and *C. punctatus* hosts in the form of encysted larvae, while they were not observed in *C. strigata*. The presence in these hosts is probably related to predation on the intermediate hosts of the parasites, in which the feeding habits play an important role in the lifecycle. The related species *Q. machadoi* was reported in *Hemisorubim platyrhynchus* in the Paraná River (GUIDELLI et al., 2003), and in *H. malabaricus* in a lagoon at Aguaí, infecting 87.5% of the fish (ROSIM et al., 2005). According to Rosim et al. (2005), *Astyanax altiparanae* is considered to be a paratenic host for *Q. torquatus*, and according to Carvalho et al. (2003), *Astyanax* spp. are considered both paratenic and intermediate hosts for *Q. torquatus*.

The results from these authors demonstrated that there was a negative correlation between the mean intensity of infection and the standard length of the host. Our observations do not support such evidence. The acanthocephalans were more prevalent in the anterior intestine of *A. bimaculatus* during the wet season, than the prevalence in the other hosts. The difference between hosts is probably due to different predation intensities of the intermediate hosts of the parasite, and the higher prevalence in *A. bimaculatus* during the wet season might be related to more abundant intermediate hosts during the wet season.

The fish of the present report are ornamental fish that are exported in great numbers to other countries. The results showed that these fish can carry several kind of parasites, both ecto and endoparasites, which can infect other fish in different continents and locations. In the literature, there are a number of reports dealing with the parasites of ornamental fish (FERRAZ; SOMMERVILLE, 1998; PIAZZA et al., 2006; THILAKARATNE et al., 2003; PRANG, 2007; MOUTON et al., 2001; GARCIA et al., 2009) and with the introduction of parasites by ornamental fish (KIM et al., 2002; MORAVEC et al., 1999; EVANS; LESTER, 2001). The consequences of parasite introduction can be detrimental to native fish, sometimes causing serious epizootics that may lead to extensive mortality as shown in relation to several species of monogeneans introduced into aquariums (BULLARD et al., 2001), into contact with farmed fish (OGAWA et al., 1995; STERUD et al., 1998) and also into natural populations with dramatic consequences (WHITTINGTON; CHISHOLM, 2003; BAKKE et al., 2002).

The parasites observed might constitute a threat to other fish species in the region where they have been introduced. Therefore, it is recommended that prophylactic measures should be taken prior to exportation of fish, and that fish should undergo a period of quarantine at the place of introduction. In the present sample, three groups of endoparasites with heteroxenous life cycles (nematodes and acanthocephalans) were found and one group of ectoparasites with a direct life cycle (monogeneans). Consequently, the prophylactic measures must be especially directed towards monogeneans, for several reasons: they are located in the gills, a particularly fragile and important fish organ; they reproduce very quickly in a closed environment given that they have a direct life cycle; and because they are ectoparasites, use of appropriate drugs is easier and more effective.

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