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AUSTRODIPLOSTOMUM COMPACTUM (LUTZ, 1928) (DIGENEA, DIPLOSTOMIDAE) INFECTING *GEOPHAGUS PROXIMUS* CASTELNAU, 1855 (CICHLIDAE, PERCIFORMES) IN THE TIETÊ RIVER, NOVA AVANHANDAVA RESERVOIR, MUNICIPALITY OF BURITAMA, SÃO PAULO STATE, BRAZIL

AUSTRODIPLOSTOMUM COMPACTUM (LUTZ, 1928) (DIGENEA, DIPLOSTOMIDAE) INFECTANDO *GEOPHAGUS PROXIMUS* CASTELNAU, 1855 (CICHLIDAE, PERCIFORMES) EN EL RÍO TIETÊ, RESERVORIO NOVA AVANHANDAVA, MUNICIPALIDAD DE BURITAMA, ESTADO DE SÃO PAULO, BRAZIL.

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Abstract

This study aimed to evaluate the infection by the *Austrodiplostomum compactum* (Lutz, 1928) metacercariae in the eyes of *Geophagus proximus* Castelnau, 1855 from the Nova Avanhandava Reservoir, medium Tietê river, municipality of Buritama, São Paulo State, Brazil. The parasites were collected from vitreous humor, fixed in AFA solution under cover slip pressure, stained with carmine and cleared with creosote. The morphometric analysis was performed using a computerized system for analysis of images QWin Lite 2.5 (Leica). Fourty-one *G. proximus* specimens were collected and 38 were infected in the humor vitreous with *A. compactum* metacercariae (prevalence = 97%). Four hundred eighty six metacercariae were recovered, range from 1 to 194 in the studied specimens. The mean intensity of infection and abundance were 12.8 ± 5.1 and 11.8 ± 4.75, respectively.

Keywords: Diplostomidae - Fish - Helminths - Tietê River.

Resumen

Este estudio tuvo como objetivo evaluar la infección por metacercanias de *Austrodiplostomum compactum* (Lutz, 1928) en los ojos de *Geophoagus proximus* Castelnau, 1855 del río Tietê Nova Avanhandava medio Presa, Municipio de Buritama, Estado de São Paulo, Brasil. Los parásitos fueron recogidos de humor vítreo, fijados en solución AFA y teñidos con carmín y aclarados con creosota. El análisis morfométrico se realizó con un sistema informatizado de análisis de imágenes QWin Lite 2,5 (Leica). Cuarenta y un ejemplares de *G. proximus* fueron colectados y 38 fueron infectados en el humor vítreo con metacercarias *A. compactum* (prevalencia = 97%). Cuatrocientos ochenta y seis metacercarias fueron recuperadas, rango 1 a 194 en los especímenes estudiados. La intensidad media de la infección y la abundancia fueron 12,8 ± 5,1 y 11,8 ± 4,75, respectivamente.

Palabras clave: Diplostomidae - Helmintos - Peces - Río Tietê.

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INTRODUCTION

Diplostomids have attracted attention because of their pathogenic metacercariae in fish (Chappell *et al.*, 1994; Niewiadomska, 1996), mainly in freshwater system of the Brazil (Martins *et al.*, 2002; Machado *et al.*, 2005; Yamada *et al.*, 2007; Zica *et al.*, 2009; Paes *et al.*, 2009a b). Fish heavily infected with the metacercariae may experience loss of vision and reduced growth (Chappell *et al.*, 1994; Chappell, 1995; Niewiadomska, 1996) or deformation of the vertebral column, brain tumour, cellular necrosis and finally death (Machado *et al.*, 2005).

Diplostomids have a three-host life cycle, which includes an avian definitive host, a snail first-intermediate host and a fish second-intermediate host (Karvonen *et al.*, 2006). An individual snail may release thousands of cercariae per day (Karvonen *et al.*, 2004a), which then penetrate fish hosts and develop to metacercariae in the lenses of the fish hosts eyes. While in fish, the parasites cause cataracts (Shariff *et al.*, 1980; Karvonen *et al.*, 2004b) which lead to the disease diplostomiasis.

Several species of diplostomid have been found in fish of the Europe, Asia, North American and a few in South American (Niewiadomska, 1996), with more of the 125 species of hosts and wide geographic distribution (Bauer, 1962; Eiras, 1994; Niewiadomska, 1996). In Brazil, *A. compactum* metacercariae have been previously reported in fishes of the order Characiformes - *Serrasalmus maculatus* (Kner, 1858) (Characidae), *Hoplias malabaricus* (Bloch, 1794) (Erythrinidae), *Schizodon borellii* (Boulenger, 1900) (Anostomidae) and *Metynnis maculatus* (Kner, 1858) (Characidae); Siluriformes - *Hypostomus regani* (Ihering, 1905) (Loricariidae), *Auchenipterus osteomystax* (Miranda-Ribeiro, 1918) (Auchenipteridae); and Perciformes - *Cichla ocellaris* Block & Schneider, 1801, *Cichla monoculus* Spix & Agassiz, 1831, *Crenicichla britskii Kullander*, 1982, *Cichlasoma paranaense* Kullander, 1983, *Geophagus brasiliensis* (Quoy & Gaimard, 1824), *Satanoperca pappaterra* (Heckel, 1840) (Cichlidae) and *Plagioscion squamosissimus* (Heckel, 1840) (Sciaenidae) (Machado *et al.*, 2005; Novaes *et al.*, 2006; Yamada *et al.*, 2008; Zica *et al.*, 2009; Paes *et al.*, 2009a b). However, there are no reports on the occurrence of the metacercariae of this species infecting *Geophagus proximus* Castelnau, 1855. The aim of this study is to report the infection case of the metacercariae of *A. compactum* in the eyes this fish species in Tietê River, Nova Avanhandava Reservoir, municipality of Buritama, São Paulo State, Brazil.

MATERIAL AND METHODS

Forty-one specimens of *G. proximus* (Figure 1) were collected on October 2008 in the Nova Avanhandava reservoir (21° 07' 29.51" S; 50° 11' 28.71" W, medium Tietê River, Municipality of Buritama, São Paulo State, Brazil (Figure 2 and 3) and were frozen until the laboratory analysis. Helminths were processed according to Eiras *et al.* (2006). Metacercariae were removed from the vitreous humor and fixed in AFA (alcohol-formaldehyde-acid acetic) solution under cover slip pressure. Specimens were stained with carmine and cleared with creosote. For morphometric analysis was utilized a computerized system for image analysis (Qwin Lite 3.2 – Leica). All measurements were presented in micrometers and represent the mean ± standard deviation (range). The voucher specimens were deposited in the Coleção Helmintológica do Departamento de Parasitologia, Instituto de Biociências (CHIBB), Universidade Estadual Paulista - UNESP, Botucatu city, São Paulo State, Brazil.

Prevalence (number of hosts infected with one or more individuals of a particular parasite species), mean intensity (average intensity of a particular species of parasite among the infected members of a particular host species) and mean abundance (total number of

individuals of a particular parasite species in a sample of a particular host divided by the total number of hosts of that species examined) were analyzed according to Bush *et al*. (1997).

RESULTS

Thirty-eight *G. proximus* specimens were infected in the humor vitreous with *A. compactum* metacercariae (prevalence = 92.7%). Four hundred eighty six metacercariae were recovered, range from 1 to 194 in the studied specimens (CHIBB 4794-4831). The mean intensity of infection and abundance were 12.8 ± 5.1 and 11.8 ± 4.75, respectively.

The main characteristics of *A. compactum* metacercariae (Figure 4) were: foliaceous body, slightly concave in the ventral face; small conical segment in the posterior region; small subterminal oral sucker; two lateral pseudosuckers in the anterior region; oval pharynx; short esophagus; intestinal caeca ending near the posterior region; oval tribocytic organ; gland cells occupying most of anterior region, extending from the beginning of intestinal caeca in the anterior region to the tribocytic organ. Data on the morphometry of *A. compactum* metacercariae is summarized in Table 1.

Table I. Morphometrical data (in micrometers) of *Austrodiplostomum compactum* (n = 22) of *Geophagus proximus* from Nova Avanhandava Reservoir, Municipality of Buritama, São Paulo State, Brazil. SE =(standard error).

Variables	Length ± SE (range)	Width ± SE (range)
Body	1708 ± 35.5 (1342-2007)	601 ± 16.1 (481-711)
Oral sucker	59 ± 3.7 (41-81)	67 ± 3.8 (47-89)
Left pseudosucker	154 ± 8.5 (108-205)	104 ± 6.6 (62-166)
Right pseudosucker	155 ± 9.1 (115-223)	99 ± 5.3 (61-119)
Pharynx	72 ± 3.1 (51-99)	51 ± 1.8 (35-66)
Esophagus	68 ± 5.1 (60-81)	-
Tribocytic organ	400 ± 7.5 (348-460)	229 ± 7.4 (165-287)
Conical segment	145 ± 6.3 (91-199)	-

DISCUSSION

In Brazil, *A. compactum* metacercariae have been reported in several fish species (Machado *et al.*, 2005; Zica *et al.*, 2009; Paes *et al.*, 2009a,b; Takemoto *et al.*, 2009), but this parasite was not reported in *G. proximus*, thus this fish species was a new host record for *A. compactum* metacercariae. However, these metacercariae have already been reported in other hosts from the Nova Avanhandava reservoir as follow, *P. squamosissimus*, *H. malabaricus*, *S. pappaterra*, *Schizodon nasutus* Kner, 1858 and *M. maculatus* (Paes *et al.*, 2009a,b).

The studied *G. proximus* species presented high prevalence the *A. compactum* metacercariae in humor vitreous. Other studies also have observed high prevalence of infection by these metacercariae, mainly infecting *P. squamosissimus* (Kohn *et al.*, 1995; Santos *et al.,* 2002; Machado *et al.*, 2005; Paes *et al.*, 2009a). Pojmanska & Chabros (1993) demonstrated that the prevalence of diplostomids was significantly lower in native fishes and higher for the introduced species. These data were also observed by Machado *et al.* (2005) in Brazil. In fact, *G. proximus*, generally known as Caratinga or Acara-tinga (Cerdeira *et al.*, 2000; Sampaio da Silva *et al.*, 2005), has its origin in the Amazon Basin – Amazonian Hydrographic Region, North of Brazil, and was introduced after construction of reservoir in seventy decade for fishery (Moretto *et al.*, 2008). This fish species has been recently catch by the fishers in the reservoirs of middle and lower Tietê River (Moretto *et al.*, 2008) and Paraná River (Graça & Pavanelli, 2007). So, according to Pojmanska & Chabros (1993) and Machado *et al.* (2005), the high prevalence of infection by *A. compactum* metacercariae in *G. proximus* could be associated to the fact that this fish species was an introduced species, which is highly susceptible to *A. compactum* infection similar to the *P. squamosissimus* (Kohn *et al.*, 1995; Santos *et al.,* 2002; Machado *et al.*, 2005; Paes *et al*., 2009a).

Figure 1. Specimen of *Geophagus proximus* from Nova Avanhandava Reservoir, Municipality of Buritama, São Paulo State, Brazil. Scale bar = 40 mm. (Foto: Ana Paula Vidoto).

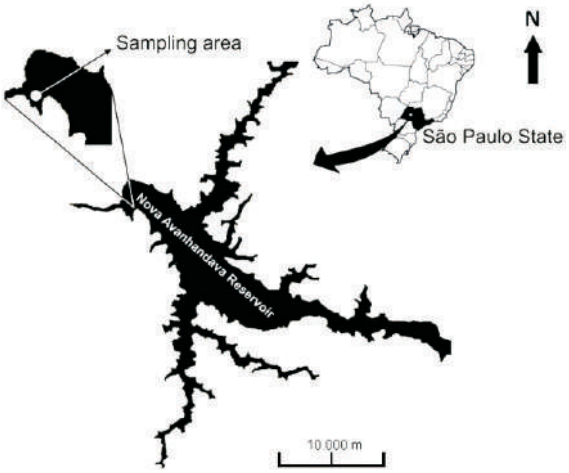

Figure 2. Map of Brazil highlighting São Paulo State and the study area at the Nova Avanhandava Reservoir, Municipality of Buritama, São Paulo State, Brazil.

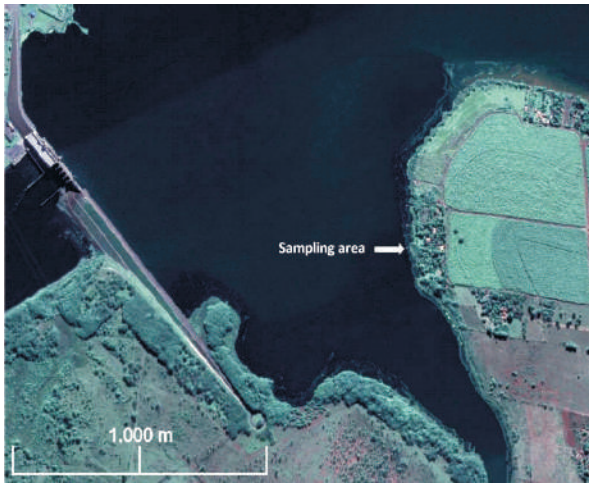

Figure 3. Detail of the sampling area at the Nova Avanhandava Reservoir, Municipality of Buritama, São Paulo State, Brazil.

Figure 4. *Austrodiplostomum compactum* metacercariae collected in the humor vitreous of *Geophagus proximus* from Nova Avanhandava Reservoir, municipality of Buritama, São Paulo State, Brazil. Scale bar = 500 m.

Recently, Moretto *et al.* (2008) studied the diet of *G. proximus* from Nova Anhandava Reservoir and demonstrated that it is essentially composed of snails of family Thiaridae, mainly the species *Aylacostoma pulcher* (Reeve, 1860), and more rarely the crustacean and insect. Thiaridae snails have been monitored worldwide because they may act as intermediate hosts of parasitic trematodes (Bogéa *et al.*, 2005; Dechruksa *et al.*, 2007). Then we suggest that *A. puncher* may be the mollusk species which act as the main intermediate host for *A. compactum* found in *G. proximus* in the Nova Avanhadava reservoir. Future studies will be conducted in order to clarify this question.

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