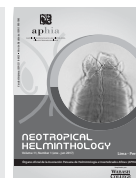


*Neotropical Helminthology*, 2017, 11(1), jan-jun: 9-16.



## Neotropical Helminthology



ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

*DIPLOSTOMUM (AUSTRODIPLOSTOMUM) COMPACTUM* (LUTZ, 1928)  
(PLATYHELMINTHES, DIGENEA) FREE METACERCARIAE IN THE EYES OF FISHES FROM  
THE FLOODPLAIN LAKES TO THE LOWER SOLIMÕES RIVER, BRAZIL

*DIPLOSTOMUM (AUSTRODIPLOSTOMUM) COMPACTUM* (LUTZ, 1928)  
(PLATYHELMINTHES, DIGENEA) METACERCARIA LIBRE EN LOS OJOS DE LOS PECES DE  
LOS LAGOS DE INUNDACIONES AL RIO INFERIOR DE SOLIMÕES, BRASIL

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### ABSTRACT

Two hundred and eighty-nine fish of 24 species and four orders were captured in Catalão, Preto and Poraquê lakes in the dry season. Thirteen species were parasitized by free metacercariae of *Diplostomum (Austrodiplostomum) compactum* (Lutz, 1928) in the eyes: *Pygocentrus nattereri* Kner, 1858, *Serrassalmus elongatus* Kner, 1858 (Serrasalmidae); *Acestrorhynchus falcirostris* (Cuvier, 1819) (Characidae); *Satanoperca jurupari* (Heckel, 1840); *Geophagus surinamensis* (Bloch, 1791), *Crenicichla johanna* Heckel, 1840, *Mesonalta festivus* (Heckel, 1840) (Cichlidae); *Plagioscion squamosissimus* Heckel, 1840 (Sciaenidae); *Loricariichthys acutus* Valenciennes, 1840, *Pterygoplichthys pardalis* (Castelnau, 1855) (Loricariidae); *Pimelodus bloch* Valenciennes, 1840 (Pimelodidae) and *Pellona castelneana* Valenciennes, 1847 (Pristigasteridae). A total of 1065 free metacercariae of *D. (A.) compactum* were collected. *Plagioscion squamosissimus* was the species with the greatest abundance of metacercariae with 640 individuals. Species of benthic fish were more parasitized than pelagic fish.

**Keyword:** Amazon – Diplostomidae – freshwater – parasites of fishes – Trematoda

## RESUMEN

Doscientos ochenta y nueve peces de 24 especies y cuatro órdenes fueron capturados en los lagos Catalão, Preto y Poraquê en la estación seca. Trece especies fueron parasitadas por metacercarias libres de *Diplostomum (Austrodiplostomum) compactum* (Lutz, 1928) en los ojos: *Pygocentrus nattereri* Kner, 1858, *Serrasalmus elongatus* Kner, 1858 (Serrasalmidae); *Acestrorhynchus falcirostris* (Cuvier, 1819) (Characidae); *Satanoperca jurupari* (Heckel, 1840); *Geophagus surinamensis* (Bloch, 1791), *Crenicichla johanna* Heckel, 1840, *Mesonalta festivus* (Heckel, 1840) (Cichlidae); *Plagioscion squamosissimus* Heckel, 1840 (Sciaenidae); *Loricariichthys acutus* Valenciennes, 1840, *Pterygoplichthys pardalis* (Castelnau, 1855) (Loricariidae); *Pimelodus bloch* Valenciennes, 1840 (Pimelodidae) y *Pellona castelneana* Valenciennes, 1847 (Pristigasteridae). Se recogieron un total de 1065 metacercarias libres de *D. (A.) compactum*. *Plagioscion squamosissimus* fue la especie con mayor abundancia de metacercarias con 640 individuos. Las especies de peces bentónicos fueron más parasitadas que las pelágicas.

**Palabras clave:** agua dulce – Amazonas – Diplostomidae – parásitos de peces – Trematoda

## INTRODUCTION

*Austrodiplostomum compactum* (Lutz, 1928) is a digenetic trematode of the order Strigeoidea whose metacercariae occur in the eyes of a wide variety of fish species (Kohn *et al.*, 1995; Martins *et al.*, 1999, 2002; Brasil-Sato & Pavanelli, 2004; Brasil-Sato & Santon, 2005; Yamada *et al.*, 2008; Zica *et al.*, 2009; 2010; Santos, 2011). The metacercariae of these digeneans can infect the vitreous humour (Amato *et al.*, 2001) and, more rarely, the brains of the intermediate fish hosts (Nuñez, 1982; Amato *et al.*, 2001).

Interest in this trematode group was stimulated in recent years because the larvae of this family can infect humans and, when present in sufficient numbers, can cause you death (Thatcher 2006). This group is closely related to fish because they are the second intermediate hosts (Santos *et al.*, 2001, 2012). In recent years, it has been reported several fish species in Brazil as host of this species. Because of the great diversity of the Amazon fish, it is evident that there is a huge amount of hosts (Malta, 1981). The aim of the present study was to investigate the occurrence of infection by *A. compactum* metacercariae in the eyes of fish from the floodplain lakes to the lower Solimões river, Brazil.

## MATERIAL AND METHODS

The fishes were collected in three lakes: Catalão (3°10'04"S; 59°54'45"W), Preto (3°21'17"S; 1°37'28,6"W and Poraquê (3°53'54,8"S; 61°40'18,4"W) during the month of November of 2015 in dry season. Mesh gill nets were used in 25 and 35 mm distance between us opposite arranged randomly on the lake, with fish removal every two hours for 48 h. The fishes were measured (standard length in cm), weighed in g, identified and preserved in 85% ethanol. Later were transported to the Fish Parasitology Laboratory where they were necropsied (Paraguassú & Luque, 2007).

To collect the metacercariae eyes were removed and was made the dissection of the ocular globe in the Petri dish (Pavanelli *et al.*, 2012). Helminthes were collected and preserved in 70% ethanol. The metacercariae were stained in carmine in the reverse process by Amato *et al.* (1991). Identification of *A. compactum* metacercariae was based on the morphological studies of Kohn *et al.* (1995) and Zica *et al.* (2009).

The drawings were made using a camera lucida attached to a light microscope. The parasitic rates were calculated according to Margolis *et al.* (1982) and Bush *et al.* (1997). Metacercariae of *A.*

*compactum* were deposited in the Coleção Não Insecta do INPA, Manaus, Amazonas State, Brazil.

## RESULTS

Two hundred and eighty-nine fish of 24 species and 4 orders were collected. Characiformes order: *Prochilodus nigricans* Agassiz, 1829 (Curimatidae); *Serrasalmus elongatus* Kner, 1858 (Serrasalmidae); *Potamorhyna altamazonica* Cope, 1878 (Curimatidae); *Potamorhyna pristigaster* (Steindachner, 1876) (Curimatidae); *Hoplias malabaricus* (Bloch 1794) (Erytrinae); *Triportheus albus* Cope, 1872 (Characidae); *Pygocentrus nattereri* Kner, 1858 (Serrasalmidae) e *Acestrorhynchus falcistrostris* (Cuvier, 1819) (Characidae), (Table 1).

Fishes of Perciformes order: *Crenicichla johanna* Heckel, 1840 (Cichlidae); *Mesonauta festivus* (Heckel, 1840) (Cichlidae); *Satanoperca jurupari* (Heckel, 1840) (Cichlidae); *Geophagus surinamensis* (Bloch, 1791) (Cichlidae) and *Plagioscion squamosissimus* Heckel, 1840 (Sciaenidae). Fishes of Clupeiformes order: *Pellona castelnaeana* Valenciennes, 1847 (Pristigasteridae); *P. flavipinnis* (Valenciennes, 1837) (Pristigasteridae), *Ilisha amazonica* (Miranda Ribeiro, 1920) (Pristigasteridae) and *Pristigaster cayana* Cuvier, 1829 (Pristigasteridae) (Table 1).

Fishes of Siluriformes order: *Pimelodus bloch* Valenciennes, 1840 (Pimelodidae); *Loricariichthys acutus* Valenciennes, 1840 (Loricariidae); *Ageneiosus inermis* (Linnaeus, 1766) (Ageneiosidae), *Hypophthalmus edentatus* Spix & Agassiz, 1829 (Hypophthalmidae), *Pterygoplichthys pardalis* (Castelnaeu, 1855) (Loricariidae), *Calophysus macropterus* (Lichtenstein, 1819) (Pimelodidae) and *Hoplosternum littorale* (Hancock, 1828) (Callichthyidae).

Twenty four species of fish were collected and thirteen were parasitized by free metacercariae of *D. (A.) compactum* (INPA – 688) in the eyes: *P. nattereri*; *A. falcistrostris*; *S. jurupari*; *G. surinamensis*; *P. squamosissimus*; *L. acutus*; *S. elongatus*; *P. bloch*; *P. castelnaeana* *P. pardalis*; *C.*

*johanna*; *P. castelnaeana* e *M. festivus*. *Loricariichthys acutus* e *P. pardalis* were also collected in the lakes Poraquê and Preto.

The length and the average weight of infected fish by metacercariae were: *P. nattereri* 19,8±1,5 and 280±50,8, *A. falcistrostris* 32,6 ± 2,3 and 346,3 ± 74,8; *S. jurupari* 14,7 ± 0,8 and 100,6 ± 12,5, *G. surinamensis* 13,2 ± 1,5 and 64,6 ± 27,5, *P. squamosissimus* 21,9 ± 2,6 e 157,4 ± 46,4, *L. acutus* 21,5 ± 1,1 and 51,3 ± 9,6. The fishes *P. pardalis* 22 e 130, *P. bloch*, 14 e 98, *P. castelnaeana* 25 e 306, *M. festivus* 10 e 22 and *C. johanna* 19 e 265 were captured only one fish of each species.

1065 metacercariae parasitizing 12 species of fish from Catalão Lake were collected. *Plagioscion squamosissimus* was the species with the greatest abundance 640 and average abundance 27.8. The largest number of metacercariae to the eye also occurred in *P. squamosissimus* with 116 specimens, followed *L. acutus* and *S. jurupari* (Figure 2). *C. johanna* exception that although a single specimen collected had a significant amount of parasites in their eyes (56). The parasitological indices and trophic habitat of the fish caught are presented in Table 1.

The metacercariae found was identified as *Diplostomum (A.) compactum*. This is the first case record of metacercariae of *A. compactum* parasitizing the *C. johanna* eyes, *P. bloch*, *L. acutus*, *S. jurupari*, *G. surinamensis*, *P. castelnaeana* and *P. nattereri* in the Amazon.

Fisheries occurred during the dry season, and the depth of the lakes was minimal, and the fish had a very small space to live. The species of benthic fish were more parasitized by *A. compactum* than pelagic species. Despite having a prevalence of 100% most species with the exception of *L. acutus* showed a low average intensity.

The main characteristics of *A. compactum* metacercariae 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. Acetabulum absent. Oval pharynx; short oesophagus; intestinal caeca ending near the posterior region. Morphometric data of *A. compactum* metacercariae are summarized in table 1.

**Table 1.** Fish species and number of collected metacercariae of thirteen species of fish captured in the lakes, Catalão, Preto and Poraquê in the Brazilian Amazon.

Species of fish	Individuals			Metacercariae
	number	Length (cm)	Weight (g)	
<i>P. nattereri</i>	12	19,8 ± 1,5	280 ± 50,8,	11
<i>A. falcistrostris</i>	3	32,6 ± 2,3	346,3 ± 74,8	23
<i>S. jurupari</i>	26	14,7 ± 0,8	100,6 ± 12,5	111
<i>G. surinamensis</i>	10	13,2 ± 1,5	64,6 ± 27,5	44
<i>P. squamosissimus</i>	26	21,9 ± 2,6	157, 4 ± 46,4	640
<i>L. acutus</i>	1	21,5 ± 1,1	51,3 ± 9,6	136
<i>P. pardalis</i>	1	22	130	37
<i>P. bloch</i>	1	14	98	1
<i>P. castelnaeana</i>	1	25	306	1
<i>M. festivus</i>	1	10	22	1
<i>C. johanna</i>	1	19	265	59
<i>S. elongatus</i>	1	17	112	1

**Table 2.** Parasitological indexes of *Diplostomum (Austrodiplostomum) compactum* parasites of thirteen species of fish captured in the lakes, Catalão, Preto and Poraquê in the Brazilian Amazon.

Host	P%	IM	AV	HA	FH	Nm
<i>Acestrorhynchus falcistrostris</i>	100	7,6±3,2	4 - 10	Pel	P	23
<i>Crenicichla johanna</i> <sup>α</sup>	100	59	-	Ben-pel	C	59
<i>Geophagus surinamensis</i>	100	4,4±3,7	1 - 10	Ben-pel	O	44
<i>Loricariichthys acutus</i> <sup>1 α</sup>	100	36,6±20,2	16 - 64	Ben	D	112
<i>Loricariichthys acutus</i> <sup>2</sup>	80	16,3±13,6	2 - 47	Ben	D	24
<i>Mesonauta festivus</i> <sup>α</sup>	100	1	2	Ben-pel	O	1
<i>Pygocentrus nattereri</i>	100	2,3±1	1 - 4	Pel	P	11
<i>Pimelodus bloch</i> <sup>α</sup>	100	1	-	Ben-pel	O	1
<i>Plagioscion squamosissimus</i>	100	27,8±29,1	1 - 116	Ben-pel	C	640
<i>Pellona castelnaeana</i> <sup>α</sup>	100	1	-	Pel	P	1
<i>Pterygoplichthys pardalis</i>	29,4	1,4±0,8	1 - 4	Ben	D	37
<i>Satanoperca jurupari</i>	100	4,2±3,6	1 - 15	Ben-pel	O	111
<i>Serrassalmus elongatus</i> <sup>α</sup>	100	1	-	Pel	O	1

P - prevalence; IM - mean intensity; AV - amplitude variation; HA - Habitat; FH - food habit; Pel - Pelagic; Ben-pel - Benthopelagic; P - piscivore; C - carnivore; O - omnivorous; D - detritivore; Nm - Number of metacercariae. α - First record. 1 - catalão, 2 - poraquê.

## DISCUSSION

In Brazil, metacercarial *D. (A.) compactum* are cited for 40 species of fish (Ramos *et al.*, 2013; Pinto *et al.*, 2014). Most species of fish parasitized belong to the Perciformes order (12 species), Siluriformes (13 species) and Characiformes (nine

species). The fishes of the Cichlidae family (10 species) and Loricariidae (eight species) showed the most parasitized species (Ramos *et al.*, 2013).

*Diplostomum (Austrodiplostomum) compactum* was cited parasitizing the eyes of *P. squamosissimus* (Kohn *et al.*, 1995), *Geophagus brasiliensis* Quoy & Gaimard, 1824 (Novaes *et al.*,

2006; Carvalho *et al.*, 2012), *Hypostomus regani* Ihering, 1905 (Zica *et al.*, 2009), *H. ancistroides* Ihering, 1911, *H. hermanni* Ihering, 1905, *H. iheringii* Regan, 1908, *H. margaritifera* Regan, 1908, *H. strigaticeps* Regan, 1908, *Hypostomus* sp. e *Megalancistrus parananus* Peters, 1881 (Zica *et al.*, 2011). The eyes of *Hoplias malabaricus* Bloch, 1794, *Geophagus surinamensis* Bloch, 1791 (Santos *et al.*, 2012); *Cichla monoculus* Spix & Agassiz, 1831, *Crenicichla britskii* Kullander, 1982, *Cichlasoma paranaense* Kullander, 1983 and *Satanoperca pappaterra* Heckel, 1840 (Machado *et al.*, 2005).

The eyes of *Geophagus proximus* Castelnau, 1855 (Zica *et al.*, 2010); *Serrasalmus maculatus* Kner, 1858; *H. regani*; *Schizodon borellii* Boulenger, 1900; *Auchenipterus osteomystax* Miranda-Ribeiro, 1918 (Yamada *et al.*, 2008). The kidneys, body cavity, peritoneum around the viscera and brain of *Loricariichthys anus* Valenciennes, 1835 (Amato *et al.*, 2001).

Twenty-two species of fish captured in the Santa Bárbara River (municipality of Buritama, São Paulo State. Five species were parasitized by *A. compactum*: *P. squamosissimus*; *S. nasutus*; *S. pappaterra*; *H. malabaricus* and *M. maculatus*. *Plagioscion squamosissimus* was the species with the highest prevalence (90%) followed by *S. pappaterra* (60%) (Paes *et al.*, 2010).

This first case record of *D. (A.) compactum* in a fish in the Amazon were in 355 *P. nattereri* captured in six floodplain lakes of Solimões River. Of fishes 85% were female and only three *D. (A.) compactum* were collected in the muscles of three male (15%) during dry season. The prevalence was 0.845%; intensity 3; average intensity  $1.0 \pm 0.45$ ; average abundance 0.01 and the range of variation 1 (Morais *et al.*, 2011).

The second case record of *D. (A.) compactum* in fish in the Amazon were in *Acestrorhynchus falcirostris* (Cuvier, 1819) captured in six floodplain lakes of Solimões River e one from Purus River. Seventy-nine fishes were examined, 34 were infected and 180 *D. (A.) compactum* were collected. The prevalence was 43.04; intensity ranged from 1 to 25; average intensity  $5.29 \pm 4.9$  and mean abundance  $2.26 \pm 4.14$ . The free metacercariae were collected in the eyes, visceral

and gill cavities and the intestine. The gill and visceral cavities and intestines are new sites of infection (Dumbo, 2014).

This paper is the third case record of *D. (A.) compactum* parasitizing fish in the Brazilian Amazon. Thirteen species of fishes occurred as a host of *D. (A.) compactum*. For *P. nattereri* parasitological indices were much higher than those found by Morais *et al.* (2011) and the metacercariae were collected only in the eyes, a new place of infestation by *D. (A.) compactum* in *P. nattereri*. For *A. falcirostris* parasitological indices too were much higher than found by Dumbo (2014), but the free metacercariae were founded only in the eyes.

In populations of *H. malabaricus*, *S. pappaterra*, *P. squamosissimus*, *C. britskii* and *C. monoculus* from the floodplain of the upper Parana' River, the metacercariae of *D. (A.) compactum* tend to present aggregated distribution, with a low degree of aggregation (Machado *et al.*, 2005). In the aggregated distribution, few individuals of the host population shelter many parasites, while many are not parasitized (Ludwig & Reynolds, 1988).

In *P. squamosissimus* from the floodplain of the upper Parana' River, the majority of the specimens were found parasitized by *D. (A.) compactum*, although few sheltered many metacercariae and the remaining a lesser number (Machado *et al.*, 2005; Lacerda *et al.*, 2012). The most severe effects caused by elevated intensities of infection are confined to few individuals and have little effects on the population as a whole (Crofton, 1971).

In this paper *D. (A.) compactum* parasite the eyes of thirteen species of fish showing the natural susceptibility of fish to this parasite (Martins *et al.*, 2002). The high prevalence rates and the average intensity are associated with environmental quality in the collection period, the dry season, which limits the living space and promotes contact between intermediate and definitive hosts, thus favoring the life cycle of *D. (A.) compactum* is complete (Mesquita *et al.*, 2011).

Probably *A. compactum* enjoy the period of less space in the aquatic environment to disperse the largest possible number of hosts in the lake. This can be seen because not all fish collected were

infected, because of their different eating habits and habitat areas. The species of benthic and pelagic fish were the ones that showed the highest abundances of *A. compactum*. The highest parasitism occurred in *P. squamosissimus* and *L. acutus*.

## BIBLIOGRAPHIC REFERENCES

- Amato, JFR, Boeger, WA, Amato, SB. 1991. *Protocolos para laboratório-coleta e processamento de parasitas do pescado*. Imprensa Universitária, Universidade Federal do Rio de Janeiro. Rio de Janeiro.
- Amato, SB, Amato, JFR, Albrecht, M. 2001. *Metacercárias livres de diplostomídeos (Digenea, Diplostomidae) em Loricariichthys anus (Val, 1840) (Siluriformes, Loricariidae) do estado do Rio Grande do Sul, Brasil*. Parasitologia al dia, vol. 25, pp. 1-7.
- Brasil-Sato, MC, Pavanelli, GC. 2004. *Digenea de Pimelodus maculatus (Osteichthyes: Pimelodidae) das bacias dos rios São Francisco e Paraná, Brasil*. Parasitologia latino-americana, vol. 59, pp. 123-131.
- Brasil-Sato, MC, Santos, MD. 2005. *Metazoan parasites of Conorhynchus conirostris (Valenciennes, 1840), an endemic siluriform fish of the São Francisco basin, Brasil*. Revista Brasileira de Parasitologia Veterinária vol. 14, pp. 160-166.
- Bush, AO, Lafferty, KD, Lotz, JM, Shostak, AW. 1997. *Parasitology meets ecology on its own terms: Margolis et al. Revisited*. Journal of Parasitology, vol. 83, pp. 575-583.
- Carvalho, AR, Azavedo, RK, Abdallah VD, Luque JLF. 2012. *Metacercárias de Diplostomidae (Digenea: Diplostomoidea) em Geophagus brasiliensis (Perciformes: Cichlidae) do rio Guandu, estado do Rio de Janeiro, Brasil*. Acta Scientiarum Biological Sciences, vol. 34, pp. 233-239.
- Crofton, HD. 1971. *A model of host-parasite relationships*. Parasitology, vol. 63, pp. 343-364.
- Dumbo, JC. 2014. *Espécies de metazoários parasitas do Acestrorhincus falcirostris (Cuvier, 1819) (Characiformes: Acestrorhinchidae) de lagos de várzea da Amazônia central*. Dissertação de mestrado em Biologia de água doce e pesca interior/INPA Manaus.
- Kohn, A, Fernandes, BMM, Baptista-Farias, MFD. 1995. *Metacercarie of Diplostomum (Austrodiplostomum) compactum (Trematoda, Diplostomidae) in the eyes of Plagioscion squamosissimus (Teleostei, Sciaenidae) from the reservoir of the hydroelectric power station of Itaipu, Brazil*. Memórias do Instituto Oswaldo Cruz, vol. 90, pp. 341-344.
- Lacerda, ACF, Takemoto, RM, Tavares-Dias, M, Poulin, R, Pavanelli, GC. 2012. *Comparative parasitism of the fish Plagioscion squamosissimus in native and invade driver basins*. Journal of Parasitology, vol. 98, pp. 713-717.
- Ludwig, JA & Reynolds JF. 1988. *Statistical ecology. A primer on methods and computing*. Jhon Wiley and Sons. New York.
- Malta, JCM. 1981. *Os crustáceos branquiúrus e suas interrelações com os peixes do lago Janauacá, AM – Brasil (Crustacea: Argulidae)*. Dissertação de Mestrado em Biologia de água doce e pesca interior INPA, Manaus.
- Machado, PM, Takemoto, RM, Pavanelli, GC. 2005. *Diplostomum (Austrodiplostomum) compactum (Lutz, 1928) (Platyhelminthes, Digenea) metacercariae in fish from the floodplain of the upper Paraná river, Brazil*. Parasitology Research, vol. 97, pp. 436-444.
- Margolis L, Esch GW, Holmes JC, Kuris AM, Schad GA (1982) *The use of ecological terms in parasitology (Report of an ad hoc committee of the American Society of Parasitologists)*. The Journal of parasitology, vol. 68, pp.131-133.
- Mesquita, RLB, Azevedo, RK, Abdallah, VD, Luque, JL. 2011. *Ectoparasites as numerical dominant species in parasite community of Trachelyopterus striatulus (Siluriformes: Auchenipteridae) from Guandu river, southeastern Brazil*. Brazilian Journal of Biology, vol. 71, pp. 623-627.
- Morais, AM, Varella, AMB, Fernandes, BMM, Malta, JCM. 2011. *Clinostomum marginatum (Braun, 1899) and Austrodiplostomum compactum (Lutz, 1928) metacercariae with zoonotic potencial*

- em *Pygocentrus nattereri* (Kner, 1858) (Characiformes: Serrasalminidae) from central Amazon, Brasil. *Neotropical Helminthology*, vol. 5, pp. 8-15.
- Martins, ML, Fujimoto, RY, Nascimento, AA, Moraes, FR. 1999. Ocorrência de *Diplostomum* sp. Nordmann, 1832 (Digenea: Diplostomidae) em *Plagioscion squamosissimus* (Heckel, 1840) proveniente do reservatório de Volta Grande, MG. *Acta Scientiarum Biological Science*, vol. 21, pp. 263-266.
- Martins, ML, Paiva, AMFC, Fujimoto, RY, Schalch, SHC, Colombano, NC. 2002. Prevalência, sazonalidade e intensidade de infecção por *Diplostomum* (*Austrodiplostomum*) *compactum* Lutz, 1928 (Digenea: Diplostomidae), em peixes do reservatório de Volta Grande, estado de Minas Gerais, Brasil. *Acta Scientiarum Biological Sciences*, vol. 24, pp. 469-474.
- Novaes, JC, Ramos, IP, Carvalho, ED, Silva, RJ. 2006. Metacercariae of *Diplostomum compactum* Lutz, 1928 (Trematoda: Diplostomidae) in the eyes of acara *Geophagus brasiliensis* Quoy & Gaimard, 1824 (Teleostei: Cichlidae) from Barra Bonita reservoir. *Arquivo Brasileiro de Medicina Veterinária e Zootocnia*, vol. 58, pp. 1229-1231.
- Núñez, MO. 1982. The life histories of *Diplostomum* (*Austrodiplostomum*) *compactum* (Lutz, 1928) and *D. (A.) mordax* (Szidat & Nani, 1951) n. comb. In *South America*. *Zoologischer Anzeiger*, vol. 208, pp. 393-404.
- Paes, JVK, Carvalho, ED, Silva, RJ. 2010. Infection by *Austrodiplostomum compactum* metacercarie in fish from the Nova Avanhadava reservoir, Tiête river, São Paulo state, Brazil. *Acta Scientiarum Biological Science*, vol. 32, pp. 273-278.
- Paraguassú, AR, Luque, JL. 2007. Metazoários parasitas de seis espécies de peixes do reservatório de Lajes, estado do Rio de Janeiro, Brasil. *Revista Brasileira de Parasitologia Veterinária*, vol. 16, pp. 121-128.
- Pavanelli, G.C.; Eiras, J.C.; Takemoto, R.M. 2002. *Doenças de Peixes: Profilaxia, Diagnóstico e Tratamento*. 2<sup>nd</sup> ed., Eduem, Maringá, Brasil.
- Pinto HA, Melo AL (2014) *Biomphalaria straminea* and *Biomphalaria glabrata* (Mollusca: Planorbidae) as new intermediate host of the fish eye fluke *Austrodiplostomum compactum* (Trematoda: Diplostomidae) in Brazil. *Journal of Parasitology*, vol. 99, pp. 729-733.
- Porto, DB, Vital, JF, Santos, AKS, Morais, AM, Varella, AMB, Malta, JCO. 2012. Metazoários parasitos de *Pterygoplichthys pardalis* (Castelnau, 1855) (Siluriformes: Loricariidae) da Amazônia central, Brasil. *Revista Brasileira de Zootecias*, vol. 14, pp. 35-40.
- Ramos, IP, Franceschini, L, Zago, AC, Zica, EOP, Wunderlich, AC, Carvalho, ED, Silva, RJ. 2013. New host records and a checklist of fishes infected with *Austrodiplostomum compactum* (Digenea: Diplostomidae) in Brazil. *Revista Brasileira de Parasitologia Veterinária*, vol. 22, pp. 511-518.
- Santos, RS, Pimenta, FDA, Martins, ML, Takahashi, HK, Marengoni, NG. 2002. Metacercárias de *Diplostomum* (*Austrodiplostomum*) *compactum* (Lutz, 1928) (Digenea, Diplostomidae) em peixes do rio Paraná, Brasil. *Prevalência, sazonalidade e intensidade de infecção*. *Acta Scientiarum Biological Science*, vol. 24, pp. 475-480.
- Santos, RS, Marchiori, N, Santarem, VA, Takashi, K, Mourinho, JLP, Martins, ML. 2012. *Austrodiplostomum compactum* (Lutz, 1928) (Digenea, Diplostomidae) in the eyes of fishes from Paraná river, Brazil. *Acta Scientiarum Biological Science*, vol. 34, pp. 225-231.
- Santos, RS. 2011. *Austrodiplostomum compactum* em peixes do Rio Paraná. Dissertação de Mestrado em Aquicultura. Presidente Prudente, São Paulo.
- Thatcher, VE. 2006. *Amazon fish parasites*. 2<sup>a</sup> Ed., Editora Aquatic Biodiversity in Latin America, Sofia, Moscow.
- Yamada, FH, Moreira, LHA, Ceschini, TL, Takemoto, RM, Pavanelli, GC. 2008. Novas ocorrências de metacercárias de *Austrodiplostomum compactum* (Lutz, 1928) (Platyhelminthes: Digenea) parasitos de olhos de peixes da bacia do rio Paraná. *Revista Brasileira de Medicina*

- Veterinária, vol. 17, pp. 163-166.
- Zica, EOP, Santos, KR, Ramos, IP, Zanatta, AS, Carvalho, ED, Silva, RJ. 2009. *First case of infection of the metacercariae of Austrodiplostomum compactum (Lutz, 1928) (Digenea: Diplostomidae) in Hypostomus regani (Ihering, 1905) (Siluriformes: Loricariidae)*. Pan-American Journal of Aquatic Sciences, vol. 4, pp. 35-38.
- Zica, EOP, Brandão, H, Zawadzki, CH, Nobile, AB, Carvalho, ED, Silva, RJ. 2011. *The*

*ocorrence of Austrodiplostomum compactum (Lutz, 1928) (Digenea: Diplostomidae) metacercariae in the eye of Loricariidae fish (Siluriformes: Osteichthyes: Loricariidae) from Brazil*. Journal of Helminthology, vol. 85, pp. 73-79.

Received September 20, 2016.  
Accepted January 25, 2017.