



Neotropical Helminthology



ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

DIVERSITY OF MONOGENEANS PARASITES FROM CHARACIFORMES FISHES IN THE BATALHA RIVER AND PEIXE'S RIVER, STATE OF SÃO PAULO, BRAZIL

DIVERSIDAD DE PARÁSITOS MONOGENÉTICOS DE LOS PECES CHARACIFORMES EN BATALHA RÍO Y RÍO DEL PEIXE, ESTADO DE SÃO PAULO, BRASIL

DIVERSIDADE DE PARASITOS MONOGENÉTICOS DOS PEIXES CHARACIFORMES NO RIO BATALHA E RIO DO PEIXE, ESTADO DE SÃO PAULO, BRASIL

Karina Gabriele Alves Dias¹; Diego Henrique Mirandola Dias Vieira¹; Aline de Almeida Camargo¹; Reinaldo José da Silva¹; Rodney Kozłowski de Azevedo²; Vanessa Doro Abdallah

¹Universidade Estadual Paulista "Júlio de Mesquita Filho" - UNESP, Brasil.

²Universidade do Sagrado Coração - USC, Brasil.

Corresponding author: Vanessa Doro Abdallah, Rua irmã Arminda, 10-50, Jardim Brasil, Bauru, São Paulo, Brasil, 17011-160. E-mail: vanessaabdallahusc@gmail.com

ABSTRACT

In this study, 41 species of Monogenea were recorded parasitizing the gills, body surface, and nasal cavity of Characiform fishes from State of São Paulo, Brazil. The hosts were caught in Batalha River and Peixe's River between 2010 and 2015. The monogenean species recorded were: *Anacanthorus sciponophallus* Van Every & Kritsky, 1992, *Cacatuocotyle guaibensis* Gallas, Calegari-Marques & Amato, 2014, *Cacatuocotyle paranaensis* Boeger, Domingues & Kritsky, 1997, *Calpidothecium* sp., *Characithecium* sp., *Curvianchoratus hexacleidus* Hanek, Molnar & Fernando, 1974, *Curvianchoratus singularis* (Suriano, 1980) Suriano, 1986, Dactylogyridae gen. sp. 1, Dactylogyridae gen. sp. 2, *Demidospermus paravalenciennesi* Gutiérrez & Suriano, 1992, *Diaphorocleidus* sp.1, *Diaphorocleidus* sp.2, *Diaphorocleidus* sp.3, *Diaphorocleidus* sp.4, *Diaphorocleidus kabatai* (Molnar, Hanek & Fernando, 1974) Jogunoori, Kritshy & Venkatanarasaiah, 2004, *Diaphorocleidus orthodus* Mendonza-Franco, Reina & Torchin, 2009, *Jainus* sp., *Jainus amazonensis* Kritsky, Thatcher & Kayton, 1980, *Jainus hexops* Kritsky & Leiby, 1972, *Jainus leporini* Abdallah, Azevedo & Luque, 2012, *Notothecium deleastoideum* (Kritsky, Boeger & Jégu, 1998), *Notothecium minor* Boeger & Kritsky, 1988, *Palombitrema triangulum* (Suriano, 1981) Suriano, 1997, *Pavanelliella* sp., *Philocorydoras margolisi* (Molnar, Hanek & Fernando, 1974), *Rhinoxenus arietinus* (Kritsky, Boeger & Thatcher, 1988), *Rhinoxenus curimbatae* Domingues & Boeger, 2005, *Rhinoxenus piranhus* Kritsky, Boeger & Thatcher, 1988, *Sciadicleithrum* sp.1, *Tereancistrum ornatus* Kritsky, Thatcher & Kayton, 1980, *Tereancistrum toksonum* Lizama, Takemoto & Pavanelli, 2004, *Trinibaculum altiparanae* (Abdallah, Azevedo & Silva, 2013), *Urocleidoides* sp., *Urocleidoides aimarai* Moreira, Scholz & Luque, 2015, *Urocleidoides cuiabai* Rosim, Mendoza-Franco & Luque, 2011, *Urocleidoides eremitus* Kritsky, Thatcher & Boeger, 1986, *Urocleidoides malabaricus* Rosim, Mendoza-Franco & Luque 2011, *Urocleidoides paradoxos* (Kritsky, Thatcher & Boeger, 1986), *Urocleidoides trinidadensis* Molnar, Hanek & Fernando, 1974, Gyrodactylidae gen. sp. and *Gyrodactylus* sp.2. Of these species, 29 species are new host records. Besides that, 22 and 14 species are new geographical records for Batalha River and Peixe's River, respectively.

Key words: Dactylogyridae – gills – Gyrodactylidae – nasal cavity – Platyhelminthes – body surface

RESUMO

Neste estudo, 41 espécies de Monogenea foram registradas parasitando as brânquias, superfície corporal e cavidade nasal de peixes Characiformes do Estado de São Paulo, Brasil. Os hospedeiros foram coletados no rio Batalha e no rio do Peixe entre 2010 e 2015. As espécies de monogenéticos registrados foram: *Anacanthorus sciponophallus* Van Every & Kritsky, 1992, *Cacatuocotyle guaibensis* Gallas, Calegari-Marques & Amato, 2014, *Cacatuocotyle paranaensis* Boeger, Domingues & Kritsky, 1997, *Calpidothecium* sp., *Characithecium* sp., *Curvianchoratus hexacleidus* Hanek, Molnar & Fernando, 1974, *Curvianchoratus singularis* (Suriano, 1980) Suriano, 1986, Dactylogyridae gen. sp. 1, Dactylogyridae gen. sp. 2, *Demidospermus paravalenciennesi* Gutiérrez & Suriano, 1992, *Diaphorocleidus* sp.1, *Diaphorocleidus* sp.2, *Diaphorocleidus* sp.3, *Diaphorocleidus* sp.4, *Diaphorocleidus kabatai* (Molnar, Hanek & Fernando, 1974), *Diaphorocleidus orthodus* Mendoza-Franco, Reina & Torchin, 2009, *Jainus* sp., *Jainus amazonensis* Kritsky, Thatcher & Kayton, 1980, *Jainus hexops* Kritsky & Leiby, 1972, *Jainus leporini* Abdallah, Azevedo & Luque, 2012, *Notothecium deleastoideum* (Kritsky, Boeger & Jégu, 1998), *Notothecium minor* Boeger & Kritsky, 1988, *Palombitrema triangulum* (Suriano, 1981) Suriano, 1997, *Pavanelliella* sp., *Philocorydoras margolisi* Molnar, Hanek & Fernando, 1974, *Rhinoxenus arietinus* (Kritsky, Boeger & Thatcher, 1988), *Rhinoxenus curimbatae* Domingues & Boeger, 2005, *Rhinoxenus piranhus* Kritsky, Boeger & Thatcher, 1988, *Sciadicleithrum* sp.1, *Tereancistrum ornatus* Kritsky, Thatcher & Kayton, 1980, *Tereancistrum toksonum* Lizama, Takemoto & Pavanelli, 2004, *Trinibaculum altiparanae* (Abdallah, Azevedo & Silva, 2013), *Urocleidoides* sp., *Urocleidoides aimarai* Moreira, Scholz & Luque, 2015, *Urocleidoides cuiabai* Rosim, Mendoza-Franco & Luque, 2011, *Urocleidoides eremitus* Kritsky, Thatcher & Boeger, 1986, *Urocleidoides malabaricus* Rosim, Mendoza-Franco & Luque 2011, *Urocleidoides paradoxos* (Kritsky, Thatcher & Boeger, 1986), *Urocleidoides trinidadensis* Molnar, Hanek & Fernando, 1974, Gyrodactylidae gen. sp. e *Gyrodactylus* sp.2. Destas espécies, 29 espécies apresentaram novos registros de hospedeiro. Além disso, 22 e 14 espécies são novos registros geográficos para o rio Batalha e rio do Peixe, respectivamente.

Palavras-chave: Dactylogyridae – brânquias – Gyrodactylidae – cavidade nasal – Platyhelminthes – superfície do corpo

INTRODUCTION

Fishes are considered the most parasitized vertebrates. The characteristics of the aquatic environment facilitates the spread, reproduction, and the life cycle of parasites, which creates high levels of infection/infestation in fishes (Malta, 1984).

Characiformes are distinguished by species diversity, ecological, morphological, and the amplitude size. The diversity of sizes is marked both by very small species that do not exceed 26 mm, as species of more than one-meter standard length (Weitzman & Vari, 1988). In Characiform, monogeneans can be found parasitizing gills, skin, fins, nostrils, ureters, and few in bowel ducts (Boeger & Vianna, 2006). They are

hermaphrodites, with direct life cycle, which make easier parasitic reinfestations, one of the major problems for fish farming (Dominguez, 2004).

The presence of monogeneans in fish gills can cause cell hyperplasia, mucus hypersecretion, and fusion of filaments of gill lamellae resulting in death. Injuries in the skin can cause secondary infections (Pavanelli *et al.*, 1998; Pavanelli *et al.*, 2008). Thus, global biodiversity has been very currently discussed as through the study of parasites, upgrading our knowledge about diseases affecting aquatic organisms, to recognize aspects of the habitat and biology of their hosts. In addition, parasite diversity are important biological indicators for local water quality (MacKenzie *et al.*, 1995).

Therefore, analysis of the parasites on the Batalha

River and Peixe's River can help on the understanding of river quality impact. From the Batalha River, only records of Castro (1997) and Santos & Heubel (2008) reported as 35 the number of fish species. The Batalha River covers 167 km, and is considered one of the most important tributaries of Tiete River. The water is considered good quality, furthermore, this river is responsible for supplying 45% for Bauru population. However, actually the Batalha River is undergoing an intense pollution process. Thereby changing the water quality, contributing to the silting of the river and pollution the water (Silva *et al.*, 2009). Meanwhile, the Peixe's River has its sources located in the municipality of Torre de Pedra, São Paulo State, in the region of the Environmental Protection Area (APA) of the Basaltic Cuesta of Botucatu covering a sub-basin of equivalent drainage 584.0 Km² in the direction of the axis South North. In the Peixe's River has been observed an increasing human settlement and intensive agricultural activities and cattle ranching activities (Novaes, 2008) which change the water quality. Therefore, these two rivers have a wide variety of fishes to be exploited in ichthyologic studies and the present study offers information about the ectoparasites through a checklist of monogeneans species of Characiformes fishes from Batalha River and Peixe's River.

MATERIAL AND METHODS

In Batalha River were collected 318 fish specimens of nine species: *Astyanax altiparanae* Garutti & Britski, 2000, *Astyanax bockmanni* Vari & Castro, 2007, *Astyanax fasciatus* (Cuvier, 1819), *Cyphocharax modestus* (Fernández-Yépez, 1948), *Hoplias malabaricus* (Bloch, 1794), *Leporinus friderici* (Bloch, 1794), *Moenkhausia intermedia* Eigenmann, 1908, *Roeboides descalvadensis* Fowler, 1932, *Serrasalmus maculatus* (Kner, 1858). In Peixe's River were collected 180 fish specimens of nine species: *Acestrorhynchus lacustris* (Lütken, 1875), *A. altiparanae*, *C. modestus*, *Cyphocharax nagelii* (Steindachner, 1881), *Prochilodus lineatus* (Valenciennes, 1837), *Roeboides paranensis* (Pignalberi, 1975), *S. maculatus*, *Steindachnerina insculpta* (Fernández-Yépez, 1948), *Triporthus angulatus* (Spix &

Agassiz, 1829). Fish collection was conducted with the authorization of SISBIO (n° 40998-3).

Fish were collected along the Batalha River (22°24'46"S and 49°08'05"O) between August 2013 and June 2015 and in Peixe's River (22°12'41"S and 49°39'52"W) between 22 and 26 March 2010 and from 9 to 13 August 2010. For the collection gillnets with different mesh and trawls were used.

The fish were necropsied and their gills, skin, and nasal cavity were washed in 53 µm sieve and surveyed for monogeneans under stereomicroscope. Some specimens were stained with Gomori's trichrome and mounted in Canada balsam while other specimens were mounted in Gray & Wess' medium (Humason, 1979) for study of sclerotized structures. The prevalence was calculated according to Bush *et al.* (1997). Trinocular microscopy (Nikon E200) was used for morphological analysis. The list follows the classification and systematic arrangements of the Boeger & Vianna (2006). The parasites are arranged according to the phylum, class, order, and family, and the species are presented in alphabetical order. Species of fishes are arranged in alphabetical sequence and valid names are adopted from FishBase (Froese & Pauly, 2017). The following conventions in relation to the parasite records were observed: NHR refers to a new host record and * and ** refers to Batalha River and Peixe's River as news geographical records, respectively. Voucher specimens were deposited in Coleção Helminológica do Instituto de Biociências (CHIBB), UNESP, campus de Botucatu/SP.

RESULTS

In total, 41 species of monogeneans were registered in this study. Of these species, 29 species are new host records. Besides that, 22 and 14 species are new geographical records for Batalha River and Peixe's River, respectively.

Anacanthorus sciponophallus Van Every & Kritsky, 1992 was the most prevalent species (73,33% for Batalha River and 70% for Peixe's River) parasiting *S. maculatus*, followed by *Jaimus*

hexops Kritsky & Leiby, 1972 parasitizing *R. descalvadensis* (66,7%) from Batalha River and *Palombitrema Triangulum* (Suriano, 1981) Suriano, 1997, parasitizing *C. nagelii* (67%) from Peixe's River. The species with the lowest prevalence were Dactylogyridae gen. sp. 1 and *Sciadicleithrum* sp.1 (2.5%), both in Batalha River. In Peixe's River, the species with the lowest prevalence was Dactylogyridae gen. sp. 1 (5%). Only in Peixe's River species belonging to different family of Dactylogyridae were registered, both of the family Gyrodactylidae. Some species were found in both rivers: *A. sciponophallus*, *Curvianchoratus singularis* (Suriano, 1980) Suriano, 1986, Dactylogyridae gen. sp. 1, *Diaphorocleidus* sp. 1, *Diaphorocleidus kabatai* (Molnar, Hanek & Fernando, 1974), *J. hexops*, *P. triangulum*, *Urocleidoides* sp., and *Urocleidoides eremitus* Kritsky *et al.*, 1986. *Leporinus friderici* was the more parasitized species of fish in Batalha River, being parasitized by nine species of parasites. On the Peixe's River, the most parasitized fish species was *A. altiparanae* with eight parasite species recorded.

Phylum Platyhelminthes Gegenbaur, 1859

Class Monogenea (Van Beneden, 1858)

Order Dactylogyridea Bychowsky, 1937

Family Dactylogyridae Bychowsky, 1933

Anacanthorus sciponophallus Van Every & Kritsky, 1992 */**

Host: *S. maculatus* (NHR) (Prevalence: 73.33% for Batalha River and 70% for Peixe's River)

Specimen deposited: 325 L

Location: Batalha River and Peixe's River

Site of infection: body surface, gills, and nasal cavity

Other hosts: *S. maculatus*, *Serrasalmus elongatus* Kner, 1858, *Serrasalmus rhombeus* (Linnaeus, 1766), *Serrasalmus spilopleura* Kner, 1858, *Serrasalmus* sp.

References: Van Every & Kritsky (1992), Córdova & Parisiella (2007)

Cacatuocotyle guaibensis Gallas, Calegari-Marques & Amato, 2014 *

Host: *A. altiparanae* (NHR) (Prevalence: 36.36%); *A. bockmanni* (NHR) (Prevalence: 31.58%)

Specimen deposited: 326 L

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *A. fasciatus*, *Astyanax jacuhiensis*

(Cope, 1894).

References: Gallas *et al.* (2014).

Cacatuocotyle paranaensis Boeger, Domingues & Kritsky, 1997

Host: *C. nagelii* (Prevalence: 10.8%)

Location: Peixe's River

Site of infection: body surface

Other hosts: *Characidium lanei* Travassos, 1967, *Characidium pterostictum* Gomes, 1947, *C. nagelii*, *A. fasciatus*.

References: Boeger & Vianna (2006), Vieira *et al.* (2013), Acosta *et al.* (2015).

Calpidothecium sp. *

Host: *C. modestus* (NHR) (Prevalence: 3%)

Specimen deposited: 328 L

Location: Batalha River

Site of infection: gills

Reference: Kritsky *et al.* (1997).

Characithecium sp. *

Host: *A. altiparanae* (NHR) (Prevalence: 13.63%);

A. bockmanni (NHR) (Prevalence: 26.31%); *A. fasciatus* (Prevalence: 16.13%)

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *A. aeneus*

References: Mendonza-Franco *et al.* (2009).

Curvianchoratus hexacleidus Hanek, Molnar & Fernando, 1974

Host: *C. modestus* (NHR) (Prevalence: 10%); *C. nagelii* (Prevalence: 21,7%)

Location: Peixe's River

Site of infection: body surface, gills and nasal cavity

Other hosts: *Curimata argentea* (Gill, 1858) and *C. nagelii*.

References: Boeger & Vianna (2006), Vieira *et al.* (2013).

Curvianchoratus singularis (Suriano, 1980) Suriano 1986

Host: *C. modestus* (NHR) (Prevalence: 23.33% for Batalha River); *C. nagelii* (Prevalence: 43.2% for Peixe's River); *S. insculpta* (NHR) (Prevalence: 20% for Peixe's River)

Specimen deposited: 327 L

Location: Batalha River and Peixe's River

Site of infection: body surface, gills and nasal cavity

Other hosts: *Pseudocurimata gilbert* (Quoy & Gaimard, 1824) and *C. nagelii*.
References: Boeger & Vianna (2006), Vieira *et al.* (2013).

Dactylogyridae gen. sp. 1 */**

Host: *C. modestus* (NHR) (Prevalence: 5% for Peixe's River); *C. nagelii* (NHR) (Prevalence: 8% for Peixe's River); *H. malabaricus* (Bloch, 1794) (Prevalence: 2.5% for Batalha River)

Specimen deposited: 318 L

Location: Batalha River and Peixe's River

Site of infection: gills

Other hosts: *H. malabaricus* and *H. aff. malabaricus*

References: Rosim *et al.* (2011), Graça *et al.* (2013).

Dactylogyridae gen. sp. 2 *

Host: *C. modestus* (NHR) (Prevalence: 3%)

Specimen deposited: 320 L

Location: Batalha River

Site of infection: gills

Other hosts: *C. nagelii*, *Astyanax aeneus* (Günther, 1860), *Characidium lanei* Travassos, 1967.

Demidospermus paravalenciennesi Gutiérrez & Suriano, 1992 *

Host: *L. friderici* (NHR) (Prevalence: 3%)

Specimen deposited: 332 L

Location: Batalha River

Site of infection: body surface

Other hosts: *Pimelodus clarias* (Bloch, 1794), *Pimelodus maculatus* Lacepède, 1803, and *Pimelodus* sp.

References: Kritsky & Gutierrez (1998), Santos *et al.* (2007), Cohen & Kohn (2008), Azevedo *et al.* (2010) and Monteiro *et al.* (2010).

Diaphorocleidus sp. 1 */**

Host: *A. altiparanae* (Prevalence: 38.63% in Batalha River and 42.8% for Peixe's River); *A. bockmanni* (Prevalence: 5.26% in Batalha River); *A. fasciatus* (Prevalence: 41.93% in Batalha River); *R. paranensis* (NHR) (Prevalence: 25% for Peixe's River)

Specimen deposited: 329 L

Location: Batalha River and Peixe's River

Site of infection: body surface and gills

Other hosts: *Gymnocorymbus ternetzi* (Boulenger, 1895).

References: Jogunoori *et al.* (2004).

Diaphorocleidus sp. 2 */**

Host: *A. altiparanae* (Prevalence: 47.43%); *A. bockmanni* (Prevalence: 10.52%); *A. fasciatus* (Prevalence: 32.26%)

Specimen deposited: 330 L

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *Gymnocorymbus ternetzi* (Boulenger, 1895).

References: Jogunoori *et al.* (2004).

Diaphorocleidus sp. 3 */**

Host: *A. altiparanae* (Prevalence: 20.45%); *A. fasciatus* (Prevalence: 22.58%)

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *Gymnocorymbus ternetzi* (Boulenger, 1895).

References: Jogunoori *et al.* (2004).

Diaphorocleidus sp. 4 */**

Host: *A. lacustris* (NHR, NGR**) (Prevalence: 20%)

Specimen deposited: 331 L

Location: Peixe's River

Site of infection: gills

Other hosts: *Gymnocorymbus ternetzi* (Boulenger, 1895).

References: Jogunoori *et al.* (2004).

Diaphorocleidus kabatai (Molnar, Hanek & Fernando, 1974) Jogunoori, Kritsky & Venkatanarasaiah, 2004 *

Host: *A. altiparanae* (NHR) (Prevalence: 22.73% in Batalha River and 40% for Peixe's River); *A. fasciatus* (Prevalence: 25.80% for Batalha River)

Location: Batalha River and Peixe's River

Site of infection: body surface and gills

Other hosts: *Astyanax bimaculatus* (Linnaeus, 1758), *A. fasciatus*, *A. aeneus*, *S. insculpta*, *A. fasciatus*, and *A. altiparanae*.

References: Molnar *et al.* (1974), Kritsky *et al.* (1986), Jogunoori *et al.* (2004), Boeger & Vianna (2006), Mendonza-Franco *et al.* (2009), Acosta *et al.* (2013), Acosta *et al.* (2015), Camargo *et al.* (2016).

Diaphorocleidus orthodusus Mendonza-Franco, Reina & Torchin, 2009

Host: *A. altiparanae* (Prevalence: 13.3%)

Location: Peixe's River

Site of infection: gills

Other hosts: *Astyanax orthodus* Eigenmann, 1907 and *A. altiparanae*.

References: Mendonza-Franco *et al.* (2009), Camargo *et al.* (2016).

Jainus sp. **

Host: *T. angulatus* (NHR) (Prevalence: 10%)

Specimen deposited: 333 L

Location: Peixe's River

Site of infection: gills and nasal cavity

References: Mizelle *et al.* (1968).

Jainus amazonensis Kritsky, Thatcher & Kayton, 1980 *

Host: *M. intermedia* (NHR) (Prevalence: 6.7%); *L. friderici* (NHR) (Prevalence: 9%)

Specimen deposited: 335 L

Location: Batalha River

Site of infection: body surface

Other hosts: *Brycon melanopterus* (Cope, 1872), *Brycon cephalus* (Günther, 1869), and *Brycon amazonicus* (Spix & Agassiz, 1829).

References: Kritsky *et al.* (1980), Andrade *et al.* (2001), Andrade & Malta (2006), Delgado *et al.* (2014).

Jainus hexops Kritsky & Leiby, 1972 *

Host: *A. altiparanae* (Prevalence: 25% in Batalha River and 7.6% for Peixe's River); *A. fasciatus* (Prevalence: 22.58% in Batalha River); *M. intermedia* (NHR) (Prevalence: 56.7% in Batalha River); *R. descavadensis* (NHR) (Prevalence: 66.7% in Batalha River); *R. paranensis* (Prevalence: 60% for Peixe's River).

Specimen deposited: 334 L

Location: Batalha River and Peixe's River

Site of infection: body surface, gills and nasal cavity

Other hosts: *A. fasciatus*, *A. altiparanae*, *Moenkhausia sanctaefilomenae* (Steindachner, 1907) and *Hemibrycon surinamensis* Géry, 1962.

References: Boeger & Vianna (2006), Takemoto *et al.* (2009), Hoshino *et al.* (2014), Camargo *et al.* (2016).

Jainus leporini Abdallah, Azevedo & Luque, 2012 *

Host: *H. malabaricus* (NHR) (Prevalence: 10%); *L. friderici* (NHR) (Prevalence: 18.8%)

Specimen deposited: 321 L

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *Leporinus copelandii* Steindachner, 1875.

References: Abdallah *et al.* (2012).

Notothecium deleastoideum (Kritsky, Boeger & Jégu, 1998) **

Host: *S. maculatus* (NHR) (Prevalence: 33.3%)

Location: Peixe's River

Site of infection: gills and body surface

Other hosts: *Serrasalmus* sp, and *S. rhombeus*.

References: Kritsky (1998b), Boeger & Vianna (2006), Córdova & Pariselle (2007).

Notothecium minor Boeger & Kritsky, 1988 *

Host: *S. maculatus* (NHR) (Prevalence: 30%)

Specimen deposited: 336 L

Location: Batalha River

Site of infection: body surface, gills and nasal cavity

Other hosts: *Sternarchogiton nattereri* (Steindachner, 1868), *Pygocentrus nattereri* Kner, 1858, *S. elongates*, *S. rhombeus*, *S. spilopleura*, and *Serrasalmus* sp.

References: Boeger & Kritsky (1988), Kritsky (1996).

Palombitrema triangulum (Suriano, 1981) Suriano, 1997 *

Hosts: *C. modestus* (Prevalence: 17% for Batalha River and 47% for Peixe's River); *C. nagelii* (Prevalence: 67% for Peixe's River)

Location: Batalha River and Peixe's River

Specimens deposited: 338 L

Site of infection: gills

Other hosts: *C. gilbert* (Quoy & Gaimard, 1824), *C. nagelii*, and *C. modestus*.

References: Vieira *et al.* (2013), Abdallah *et al.* (2015).

Pavanelliella sp. **

Host: *P. lineatus* (NHR) (Prevalence: 10%)

Specimen deposited: 337 L

Location: Peixe's River

Site of infection: nasal cavity

Other hosts: *Calophysus macropterus* (Lichtenstein, 1819), and *Pseudoplatystoma corruscans* (Spix & Agassiz, 1829).

References: Kritsky & Boeger (1998c).

Philocorydoras margolisi (Molnar, Hanek & Fernando, 1974) Yamada, Brandão, Yamada & Da Silva, 2015 **

Host: *S. insculpta* (NHR) (Prevalence: 6.6%)

Specimen deposited: 313 L

Location: Peixe's River

Site of infection: gills

Other hosts: *Corydoras aeneus* (Gill, 1858).

References: Molnar *et al.* (1974), Boeger & Vianna (2006), Yamada *et al.* (2015).

Rhinoxenus arietinus (Kritsky, Boeger & Thatcher, 1988) *

Host: *L. friderici* (NHR) (Prevalence: 9%)

Location: Batalha River

Site of infection: body surface

Other hosts: *Schizodon fasciatus* Spix & Agassiz, 1829, and *Leporinus agassizii* Steindachner, 1876.

References: Kritsky *et al.* (1988), Domingues & Boeger (2005), Guidelli *et al.* (2009), *L. lacustris* (Campos, 1945).

Rhinoxenus curimbatae Domingues & Boeger, 2005 **

Host: *P. lineatus* (Prevalence: 13.3%)

Specimen deposited: 339 L

Location: Peixe's River

Site of infection: nasal cavity

Other hosts: *P. lineatus*.

References: Domingues & Boeger (2005), Boeger & Vianna (2006).

Rhinoxenus piranhus Kritsky, Boeger & Thatcher, 1988 *

Host: *S. maculatus* (NHR) (Prevalence: 70%)

Specimen deposited: 340 L

Location: Batalha River

Site of infection: body surface, gills, and nasal cavity

Other hosts: *P. nattereri*, *S. nattereri*, *Serrasalmus altuvei* Ramírez, 1965, and *S. spilopleura*.

References: Kritsky *et al.* (1988), Leão *et al.* (1991), Iannacone & Luque (1993), Domingues & Boeger (2005), Vital *et al.* (2011).

Sciadicleithrum sp. 1 *

Host: *H. malabaricus* (NHR) (Prevalence: 2.5%)

Location: Batalha River

Site of infection: Gill

Other hosts: *Aequidens coeruleopunctatus* (Kner, 1863), *A. fasciatus*, *Geophagus brasiliensis* (Quoy & Gaimard, 1824), *Piabucina panamensis* Gill, 1877, *Poecilia gillii* (Kner & Steindachner, 1863)

Rhamdia guatemalensis (Günther, 1864), and *Satanoperca jurupari* (Heckel, 1840).

References: Kritsky *et al.* (1989).

Tereancistrum ornatus Kritsky, Thatcher & Kayton, 1980 **

Host: *P. lineatus* (NHR) (Prevalence: 33.3%)

Specimen deposited: 342 L

Location: Peixe's River

Site of infection: gills and nasal cavity

Other hosts: *Prochilodus reticulatus* Valenciennes, 1850

References: Kritsky *et al.* (1980).

Tereancistrum toksonum Lizama, Takemoto & Pavanelli, 2004 **

Host: *P. lineatus* (Prevalence: 33.3%)

Specimen deposited: 341 L

Location: Peixe's River

Site of infection: gills and nasal cavity

Other hosts: *P. lineatus*.

Remarks: Lizama *et al.* (2004), Takemoto *et al.* (2009), Chemes & Gervasoni (2013).

Trinibaculum altiparanae (Abdallah, Azevedo & Silva, 2013)

Host: *A. altiparanae* (Prevalence: 50%)

Specimen deposited: 343 L

Location: Peixe's River

Site of infection: gills

Other hosts: *A. altiparanae*.

References: Abdallah *et al.* (2013), Camargo *et al.* (2016).

Urocleidoides sp.

Host: *A. altiparanae* (Prevalence: 13,3% for Peixe's River); *L. friderici* (Prevalence: 15,5% for Batalha River)

Location: Batalha River and Peixe's River

Site of infection: gills

Other hosts: *Characidium caucanum* Eigenmann, 1912, *Ctenolucius beani* (Fowler, 1907), *C. argentea*, *H. malabaricus*, *Rhytiodus microlepis* Kner, 1858, and *Saccodon dariensis* (Meek & Hildebrand, 1913).

Urocleidoides aimarai Moreira, Scholz & Luque, 2015 *

Hosts: *H. malabaricus* (NHR) (Prevalence: 5%), *L. friderici* (NHR) (Prevalence: 3%)

Specimen deposited: 316 L

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *H. aimara* (Valenciennes, 1847).

References: Moreira *et al.* (2015).

Urocleidoides cuiabai Rosim, Mendoza-Franco & Luque, 2011 *

Hosts: *H. malabaricus* (Prevalence: 22.5%); *L. friderici* (NHR) (Prevalence: 3%)

Specimen deposited: 314 L

Location: Batalha River

Site of infection: body surface and gills

Other hosts: *H. malabaricus*.

References: Rosim *et al.* (2011), Graça *et al.* (2013).

Urocleidoides eremitus Kritsky, Thatcher & Boeger, 1986 */**

Host: *H. malabaricus* (Prevalence: 5% for Peixe's River); *L. friderici* (NHR) (Prevalence: 3% for Batalha River)

Specimen deposited: 317 L

Location: Batalha River and Peixe's River

Site of infection: gills

Other hosts: *H. malabaricus*.

References: Kritsky *et al.* (1986), Iannacone & Luque (1993), Boeger & Vianna (2006), Rosim *et al.* (2011), Graça *et al.* (2013), Corrêa *et al.* (2013), Alcântara & Tavares-Dias (2015), Gonçalves *et al.* (2016).

Urocleidoides malabaricus Rosim, Mendoza-Franco & Luque 2011*

Host: *H. malabaricus* (Prevalence: 7.5%)

Specimen deposited: 315 L

Location: Batalha River

Site of infection: gills

Other hosts: *H. malabaricus*, and *Zungaro zungaro* (Humboldt & Valenciennes, 1821) (= *Cephalosilurus zungaro*).

References: Rosim *et al.* (2011), Kritsky & Thatcher (1986), Graça *et al.* (2013), Gasques *et al.* (2015).

Urocleidoides paradoxus (Kritsky, Thatcher & Boeger, 1986) *

Host: *L. friderici* (Prevalence: 3%)

Location: Batalha River

Site of infection: gills

Other hosts: *L. friderici*, *L. lacustris*, *Leporinus obtusidens* (Valenciennes, 1837) e *Leporinus elongatus* Valenciennes, 1850, and *Rhytidodus microlepis* Kner, 1858.

References: Kritsky *et al.* (1986), Guidelli *et al.* (2006), Takemoto *et al.* (2009), Guidelli *et al.*

(2011).

Urocleidoides trinidadensis Molnar, Hanek & Fernando, 1974

Host: *A. altiparanae* (Prevalence: 53.8%)

Specimen deposited: 344 L

Location: Peixe's River

Site of infection: gills

Other hosts: *A. bimaculatus*, *A. fasciatus*, and *A. altiparanae*.

References: Molnar *et al.* (1974), Boeger & Vianna (2006), Camargo *et al.* (2016).

Order Gyrodactylidea Bychowsky, 1937

Family Gyrodactylidae Van Beneden & Hesse, 1863

Gyrodactylidae gen. sp.

Host: *T. angulatus* (NHR) (Prevalence: 50%)

Specimen deposited: 323 L

Location: Peixe's River

Site of infection: gills

Gyrodactylus sp. 2 **

Host: *A. altiparanae* (NHR) (Prevalence: 13.3%)

Specimen deposited: 324 L

Location: Peixe's River

Site of infection: nasal cavity

Other hosts: Clupeiformes, Cyprinodontiformes, Perciformes, Siluriformes, Characiformes

DISCUSSION

According Boeger & Vianna (2006), in the class Monogenea, Dactylogyridae is the most abundant in the waters of South America, followed by species of Gyrodactylidae, which are systematically being described, which corroborates the results obtained in this study for both rivers.

In this study, 25 monogenean species obtained from nine species of hosts were found in both rivers studied. Among the species of monogeneans found, eight were present in both rivers. *Jaimus hexops* was the species that has the lowest parasitic specificity in the Batalha River, being found in four species and *C. singularis* was the one with the smallest host specificity in Peixe's River, found in three species of hosts. Monogeneans are a diverse group of parasites that exhibit a relatively high

degree of host specificity when compared to other groups of parasites (Takemoto et al., 2009). According Morand *et al.* (2002) one parasite that infects a host species is considered a specialist, while the parasites which infect multiple host species may be considered generalist, having a relationship between species richness and host specificity of monogeneans, where high parasitic richness communities are formed by specialists and generalists, while low richness with communities are formed by generalist species. According to this quote, this work presents communities with high parasite richness in both rivers.

Some of the hosts studied in this work have also been studying targets in other rivers and its parasitic fauna was analyzed using species lists, as is the case *A. altiparanae*, *A. fasciatus*, *H. malabaricus*, *L. friderici*, *S. insculpta*, and *S. maculatus*. When we compare the results obtained in this study with those conducted in other rivers, we observed that the diversity of monogeneans was higher in Batalha River and Peixe's River for all species, with the exception of *A. fasciatus* that showed a higher diversity in the Amazon according to Boeger & Vianna (2006). According to Kennedy (1982), abiotic factors can affect the abundance and prevalence of parasites. Among the main abiotic factors can be cited depth, habitat, environmental damage, pollution, temperature, and composition of hosts community. Second Sures (2008) parasites with direct life cycles are in permanent contact with the water and are therefore likely to have developed a resistance to changes in water quality. Consequently, populations of such monoxenous parasites are expected to be less affected by changing environmental conditions compared to heteroxenous parasites. These comments corroborate with the results obtained in this study, because in spite of the rivers Batalha River and Peixe's River showed good water quality, they are subject to different types of pollution and have high diversity of monogeneans compared to rivers like Paraná, Amazonas, and Guandu for the species of fish studied in this work.

This study, in addition to expanding the geographical distribution of many parasites, is also increasing the number of hosts for some species.

ACKNOWLEDGEMENTS

We thank FAPESP (Process: 2011/22292-8, 2012/23655-0), CNPq (National Council for Scientific Technological Research) and Capes for financial support and fellowships. CNPq (307808/2014-9), CNPq-PROTAX (440496/2015-2) and FAPESP 2016/50377-1 support R.J. da Silva.

BIBLIOGRAPHIC REFERENCES

- Abdallah, VD, Azevedo, RK & Luque, JLF. 2012. *Three new species of Monogenea (Platyhelminthes) parasites of fish in the Guandu river, southeastern Brazil*. Acta Scientiarum Biological Science, vol. 34, pp.483-490.
- Abdallah, VD, Azevedo, RK & Silva, RJ. 2013. *Trinibaculum altiparanae sp. n., a new dactylogyrid species (Monogenea) of the Astyanax altiparanae (Osteichthyes: Characidae) in the Peixe River, Southeastern Brazil*. Neotropical Helminthology, vol. 7, pp.211-217.
- Abdallah, VD, Azevedo, RK & Silva, RJ. 2015. *First record of Palombitrema triangulum (Suriano, 1981) Suriano, 1997 (Monogenea: Dactylogyridae) from freshwater fishes in Brazil*. Brazilian Journal of Biology, vol. 75, pp. 229-233.
- Acosta, AA, Queiroz, J, Brandão, H, Carvalho, ED & Silva, RJ. 2013. *Helminths of Steindachnerina insculpta in two distinct stretches of the Taquari River, state of São Paulo, Brazil*. Revista Brasileira de Parasitologia Veterinária, vol. 22, pp.539-547.
- Acosta, AA, Queiroz, J, Brandão, H & Silva, RJ. 2015. *Helminth fauna of Astyanax fasciatus Cuvier, 1819, in two distinct sites of the Taquari River, São Paulo State, Brazil*. Brazilian Journal of Biology, vol. 75, pp.242-250.
- Alcântara, NM & Tavares-Dias, M. 2015. *Structure of the parasites communities in two Erythrinidae fish from Amazon river system (Brazil)*. Revista Brasileira de

- Parasitologia Veterinária, vol. 24, pp.183-190.
- Andrade, SD, Malta, JDO & Ferraz, E. 2001. *Fauna parasitológica de alevinos de matrinxã, Brycon cephalus (Günther, 1869) coletados nos rios Negro e Solimões, na Amazônia Central*. Acta Amazonica, vol. 31, pp.263-273.
- Andrade, SMS & Malta, JCO. 2006. *Parasite fauna monitoring of matrinxã Brycon amazonicus (Spix e Agassiz, 1829) raised in an intensive husbandry system in a stream channel in the State of Amazonas, Brazil*. Brazilian Journal of Biology, vol. 66, pp.1123-1132.
- Azevedo, RK, Abdallah, VD & Luque JL. 2010. *Acanthocephala, Annelida, Arthropoda, Myxozoa, Nematoda and Platyhelminthes parasites of fishes from the Guandu river, Rio de Janeiro, Brazil*. Check List, vol. 6, pp.659-667.
- Boeger, WA & Kritsky, DC. 1988. *Neotropical Monogenea. 12. Dactylogyridae from Serrasalmus nattereri (Cypriniformes, Serrasalminae) and aspects of their morphologic variation and distribution in the Brazilian Amazon*. Proceedings of the Helminthological Society of Washington, vol. 55, pp.188-213.
- Boeger, WA, Domingues, MV & Kritsky, DC. 1997. *Neotropical Monogeneoidea. 32. Cacatuocotyle paranaensis ng, n. sp. (Dactylogyridae, Ancyrocephalinae) from Characidium spp. (Teleostei, Characidae) from the State of Paraná, Brazil*. Systematic Parasitology, vol. 36, pp.75-78.
- Boeger, WA & Vianna, RT. 2006. *Monogeneoidea. In Amazon Fish Parasites (Thatcher, V.E., ed.)*. Sofia: Pensoft Publishers, pp.42-116.
- 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.
- Camargo, ADA, Negrelli, DC, Pedro, NHO, Azevedo, RKD, Silva, RJD & Abdallah, VD. 2016. *Metazoan parasite of lambari Astyanax altiparanae, collected from the Peixe river, São Paulo, southeast of Brazil*. Ciência Rural, vol. 46, pp.876-880.
- Castro, ACL. 1997. *Aspectos ecológicos da comunidade ictiofaunística do reservatório de Barra Bonita, SP*. Revista Brasileira de Biologia, vol. 57, pp.665-676.
- Chemes, SB & Gervasoni, SH. 2013. *Gill parasites of Prochilodus lineatus (Valenciennes, 1836) (Pisces; Curimatidae; Prochilodontinae) in the Middle Paraná System (Argentina)*. Revista Brasileira de Parasitologia Veterinária, vol. 22, pp.619-622.
- Cohen, SC & Kohn, A. 2008. *New data on species of Demidospermus (Dactylogyridae: Monogenea) parasitizing fishes from the reservoir of the Itaipu Hydroelectric Power Station, Parana State, Brazil, with new synonymies*. Revista Brasileira de Parasitologia Veterinária, vol. 17, pp.167-170.
- Córdova, L & Pariselle A. 2007. *Monogenoidea en Serrasalmus rhombeus (Linnaeus 1766) de la Cuenca Amazónica Boliviana*. Revista Peruana de Biología, vol. 14, pp.11-16.
- Corrêa, LL, Karling, LC, Takemoto, RM, Ceccarelli, OS & Ueta, MT. 2013. *Hematological parameters of Hoplias malabaricus (Characiformes: Erythrinidae) parasitized by Monogenea in lagoons in Pirassununga, Brazil*. Revista Brasileira de Parasitologia Veterinária, vol. 22, pp.457-462.
- Delgado, PM, Malheiros, AF, Orbe, RI & Dinis Vasquez, N. 2014. *Jainus amazonensis (Monogenea: Dactylogyridae) parasites of Brycon cephalus (Günther, 1869) cultured in the lowland of the Peruvian Amazon*. Croatian Journal of Fisheries, vol. 72, pp.83-86.
- Domingues, MV & Boeger, WA. 2005. *Neotropical Monogeneoidea. 47. Phylogeny and coevolution of species of Rhinoxenus (Platyhelminthes, Monogeneoidea, Dactylogyridae) and their Characiformes hosts (Teleostei, Ostariophysi) with description of four new species*. Zoosystema, vol. 27, pp.441-467.
- Dominguez, G. 2004. *North Spain (Burgos) wild mammals ectoparasites*. Parasite, vol. 11, pp.267-272.
- Froese, R & Pauly, D. 2017. *Fishbase*. Accessed in April 04 of 2017. <<http://www.fishbase.org>>
- Gallas, M, Calegari-Marques, C & Amato, S. 2014. *A new species of Cacatuocotyle (Monogenea, Dactylogyridae) parasitizing*

- two species of *Astyanax* (*Ostariophysa*, *Characidae*) in southern Brazil. *Acta Parasitologica*, vol. 59, pp.638-642.
- Gasques, LS, Graça, RJ, Prioli, SMAP, Takemoto, RM & Prioli, AJ. 2016. Molecular characterization of *Urocleidoides cuiabai* and *U. malabaricus* (*Monogenea: Dactylogyridae*) from the trahira fish *Hoplias aff. malabaricus* in the Paraná River; *Brazil Journal of Helminthology*, vol. 90, pp.693-697.
- Gonçalves, RA, Oliveira, MSB, Neves, LR & Tavares-Dias, M. 2016. Seasonal pattern in parasite infracommunities of *Hoplerythrinus unitaeniatus* and *Hoplias malabaricus* (*Actinopterygii: Erythrinidae*) from the Brazilian Amazon. *Acta Parasitologica*, vol. 61, pp.119-129.
- Graça, RJ, Ueda, BH, Oda, FH & Takemoto, RM. 2013. *Monogenea* (*Platyhelminthes*) parasites from the gills of *Hoplias aff. malabaricus* (Bloch, 1794) (*Pisces: Erythrinidae*) in the upper Paraná River floodplain, States of Paraná and Mato Grosso do Sul, Brazil. *Check List*, vol. 9, pp.1484-1487.
- Guidelli, GM, Tavechio, WLG, Takemoto, RM & Pavanelli, GC. 2006. Fauna parasitária de *Leporinus lacustris* e *Leporinus friderici* (*Characiformes, Anostomidae*) da planície de inundação do alto rio Paraná, Brasil. *Acta Scientiarum. Biological Sciences*, vol. 28, pp.281-290.
- Guidelli, G, Takemoto, RM & Pavanelli, GC. 2009. Ecologia das infrapopulações ectoparasitas das cavidades nasais de *Leporinus lacustris* (*Anostomidae*) da planície de inundação do alto rio Paraná, Brasil. *Acta Scientiarum. Biological Sciences*, vol. 31, pp.209-214.
- Guidelli, G, Tavechio, WLG, Takemoto, RM & Pavanelli, GC. 2011. Relative condition factor and parasitism in anostomid fishes from the floodplain of the Upper Paraná River, Brazil. *Veterinary Parasitology*, vol. 177, pp.145-151.
- Hanek, G, Molnar, K & Fernando, CH. 1974. Three new genera of *Dactylogyridae* (*Monogenea*) from freshwater fishes of Trinidad. *Journal of Parasitology*, vol. 60, pp.911-913.
- Hoshino, MDFG, Hoshino, ÉM & Tavares-Dias, M. 2014. First study on parasites of *Hemibrycon surinamensis* (*Characidae*), a host from the eastern Amazon region. *Revista Brasileira de Parasitologia Veterinária*, vol. 23, pp.343-347.
- Humason, GL. 1979. *Animal tissue techniques*. W.H. Freeman, San Francisco.
- Iannaccone, JA & Luque, JL. 1993. New records of helminths parasitic on Peruvian Amazonian fishes (*Osteichthyes*). *Revista de Biología Tropical*, vol. 41, pp.303-305.
- Jogunoori, W, Kritsky, DC & Venkatanarasiah, J. 2004. *Neotropical Monogenoidea*. 46. Three new species from the gills of introduced aquarium fishes in India, the proposal of *Heterotylus ng* and *Diaphorocleidus ng*, and the reassignment of some previously described species of *Urocleidoides* Mizelle & Price, 1964 (*Polyonchoinea: Dactylogyridae*). *Systematic Parasitology*, vol. 58, pp.115-124.
- Kennedy, CR. 1982. Biotic factors. In: Mettrick, D. F. & Desser, S.S. (Eds.). *Parasites - their world and ours. Proceedings of the fifth International Congress of Parasitology. Toronto, Canada, 1982*. Elsevier Biomedical Press. Amsterdam: The Netherlands. pp.293-302.
- Kritsky, DC & Leiby, PD. 1972. *Dactylogyridae* (*Monogenea*) from the freshwater fish, *Astyanax fasciatus* (Cuvier), in Costa Rica, with descriptions of *Jainus hexops* sp. n., *Urocleidoides costaricensis*, and *U. Heteroancistrum* combs. n. *Proceedings of the Helminthological Society of Washington*, vol. 39, pp.227-230.
- Kritsky, DC, Thatcher, VE & Kayton RJ. 1980. *Neotropical Monogenoidea*. 3. Five new species from South America with the proposal of *Tereancistrum* gen. n. and *Trinibaculum* gen. n. (*Dactylogyridae: Ancyrocephalinae*). *Acta Amazonica*, vol. 10, pp.411-417.
- Kritsky, DC, Thatcher, VE & Boeger, WA. 1986. *Neotropical Monogenea*. 8. Revision of *Urocleidoides* (*Dactylogyridae, Ancyrocephalinae*). *Proceedings of the Helminthological Society of Washington*, vol. 53, pp.1-37.
- Kritsky, DC, Boeger, WA & Thatcher, VE. 1988. *Neotropical monogenea. II: Rhinoxenus*,

- new genus (Dactylogyridae: Ancyrocephalinae) with descriptions of three new species from the nasal cavities of Amazonian Characoidea.* Proceedings of the Helminthological Society of Washington, vol. 101, pp.87-94.
- Kritsky, DC, Thatcher, VE & Boeger, WA. 1989. *Neotropical Monogenea. 15. Dactylogyrids from the gills of Brazilian Cichlidae with proposal of Sciadicleithrum gen. n. (Dactylogyridae).* Proceedings of the Helminthological Society of Washington, vol. 56, pp.128-140.
- Kritsky, DC. 1996. *Neotropical Monogeneoidea. 28. Ancyrocephalinae (Dactylogyridae) of piranha and their relatives (Teleostei, Serrasalmidae) from Brazil and French Guiana: Species of Notozothecium Boeger and Kritsky, 1988, and Mymarothecium gen. n.* Proceedings of the Helminthological Society of Washington, vol.63, pp.153-175.
- Kritsky, DC, Boeger, WA & Jegu, M. 1997. *Neotropical Monogeneoidea. 30. Ancyrocephalinae (Dactylogyridae) of Piranha and Their Relatives (Teleostei, Serrasalmidae) from Brazil: Species of Calpidothecium gen. n., Calpidothecioides gen. n., Odothecium gen. n., and Notothecioides gen. n.* Journal of the Helminthological Society of Washington, vol. 64, pp.208-218.
- Kritsky, DC & Gutierrez, PA. 1998. *Neotropical Monogeneoidea. 34. Species of Demidospermus (Dactylogyridae, Ancyrocephalinae) from the gills of pimelodids (Teleostei, Siluriformes) in Argentina.* Journal of the Helminthological Society of Washington, vol. 65, pp.147-159.
- Kritsky, DC. 1998b. *Neotropical Monogeneoidea. 31. Ancyrocephalinae (Dactylogyridae) of piranha and their relatives (Teleostei, Serrasalmidae) from Brazil: species of Notothecium Boeger and Kritsky, 1988, and Enallothecium gen. n.* Journal of the Helminthological Society of Washington, vol. 65, pp.31-49.
- Kritsky, DC & Boeger, WA. 1998c. *Neotropical Monogeneoidea. 35. Pavanelliella pavanellii, a new genus and species (Dactylogyridae, Ancyrocephalinae) from the nasal cavities of siluriform fishes in Brazil.* Journal of the Helminthological Society of Washington, vol. 65, pp.160-163.
- Leão, ELM, Leite, RG, Chaves, PTC & Ferraz, R. 1991. *Aspectos da reprodução, alimentação e parasitofauna de uma espécie rara de piranha, Serrasalmus altuvei Ramirez, 1965 (Pisces Serrasalmidae) do baixo rio Negro.* Revista Brasileira de Biologia, vol. 51, pp.545-553.
- Lizama, MDLAP, Takemoto, RM & Pavanelli, GC. 2004. *New species of Tereancistrum Kritsky, Thatcher & Kayton, 1980 (Monogenea: Dactylogyridae: Ancyrocephalinae) from the gills of Prochilodus lineatus (Osteichthyes: Prochilodontidae) from the upper Paraná River floodplain, Brazil.* Systematic Parasitology, vol. 57, pp.45-49.
- MacKenzie, K, Williams, HH, Williams, B, McVicar, AH & Siddall, R. 1995. *Parasites as indicators of water quality and the potential use of helminth transmission in marine pollution studies.* Advances in Parasitology, vol. 35, pp.85-114.
- Malta, JCDO. 1984. *Os peixes de um lago de várzea da Amazônia Central (Lago Janauacá, Rio Solimões) e suas relações com os crustáceos ectoparasitas (Branchiura: Argulidae).* Acta Amazonica, vol. 14, pp.355-372.
- Mendonza-Franco, EF, Reina, RG & Torchin, ME. 2009. *Dactylogyrids (Monogenea) parasitizing the gills of Astyanax spp. (Characidae) from Panama and Southeast Mexico, a new species of Diaphorocleidus and a proposal for Characithecium n. gen.* Journal of Parasitology, vol. 95, pp.46-55.
- Mizelle, JD, Kritsky, DC & Crane, JW. 1968. *Studies on monogenetic trematodes. XXXVIII. Ancyrocephalinae from South America with the proposal of Jainus gen. n.* American Midland Naturalist Journal, vol. 80, pp.186-198.
- Molnar, K, Hanek, G & Fernando, CH. 1974. *Ancyrocephalids (Monogenea) from freshwater fishes of Trinidad.* Journal of Parasitology, vol. 60, pp.914-920.
- Monteiro, CM, Kritsky, DC & Brasil-Sato, MC. 2010. *Neotropical Monogeneoidea. 55. Dactylogyrids parasitising the pintado-amarelo Pimelodus maculatus Lacépède (Actinopterygii: Pimelodidae) from the Rio São Francisco, Brazil.* Systematic

- Parasitology, vol. 76, pp.179-190.
- Moreira, J, Scholz, T & Luque, JL. 2015. *First data on the parasites of Hoplias aimara (Characiformes): description of two new species of gill monogeneans (Dactylogyridae)*. Acta Parasitologica, vol. 60, pp.254-260.
- Novaes, JLC. 2008. *Estudo comparativo da pesca artesanal em dois grandes reservatórios do alto Paraná: Barra Bonita (Rio Tietê) e Jurumirim (Rio Paranapanema)*. Accessed in April 04 of 2017. <http://www.dominiopublico.gov.br/pesquisa/DetalheObraForm.do?select_action=&co_obra=94296>
- Pavanelli, GC, Eiras, JC & Takemoto, RM. 1998. *Doenças de peixes*. Nupelia, Maringá, PR.
- Pavanelli, GC, Eiras, JC, Takemoto, RM. 2008. *Doença de peixes, profilaxia, diagnóstico e tratamento*. Eduem, Maringá, PR.
- Rosim, DF, Mendoza-Franco, EF & Luque, JL. 2011. *New and previously described species of Urocleidoides (Monogenoidea: Dactylogyridae) infecting the gills and nasal cavities of Hoplias malabaricus (Characiformes: Erythrinidae) from Brazilian*. Journal of Parasitology, vol. 97, pp.406-417.
- Santos, MDD, Lemos-Pita, SRLC & Brasil-Sato, MDC. 2007. *Metazoan parasite fauna of Pimelodus maculatus La Cépède, 1803 (Siluriformes, Pimelodidae) from the Guandu river, Rio de Janeiro State, Brazil*. Acta Scientiarum. Biological Sciences, vol. 29, pp.101-107.
- Santos, FS & Heubel, MTCD. 2008. *General Composição da comunidade ictológica e biometria taxológica na lagoa de captação de água do DAE no rio Batalha (Bauru-SP)*. Salusvita, vol. 27, pp.29-44.
- Silva, FL, Talamoni, JLB, Bochini, GL, Ruiz, SS & Moreira, DC. 2009. *Macroinvertebrados aquáticos do reservatório do rio Batalha para a captação das águas e abastecimento do Município de Bauru, SP, Brasil*. Revista Ambiente & Água, vol. 4, pp.66-74.
- Sures, B. 2008. *Environmental parasitology. Interactions between parasites and pollutants in the aquatic environment*. Parasite, vol. 15, pp.434-438.
- Suriano, DM. 1980. *Notodiplocerus singularis gen. et sp. nov. (Monogenea Ancyrocephalinae parasita de las branquias de Pseudocurimata gilberti (Pisces Tetragonopteridae) de la Laguna de Chascomus, Republica Argentina*. Neotropica, vol. 26, pp.131-143.
- Suriano, DM. 1981. *Androspira gen. nov. (Monogenea Ancyrocephalinae), parasito branquial de Psedocurimata gilberti (Quoy y Gaimard, 1824) Fernandez Yopez, 1948 (Pisces Tetragonopteridae) de la laguna Chascomús, República Argentina*. Neotropica, vol. 27, pp.67-78.
- Takemoto, RM, Pavanelli, GC, Lizama, MAP, Lacerda, ACF, Yamada, FH, Moreira, LHA, Ceschini, TL & Bellay, S. 2009. *Diversity of parasites of fish from the Upper Paraná River floodplain, Brazil*. Brazilian Journal of Biology, vol. 69, pp.691-705.
- Van Every, LV & Kritsky, D. 1992. *Anacanthorus Mizelle and Price, 1965 (Dactylogyridae, Anacanthorinae) of Piranha (Characoidei, Serrasalmidae) from the Central Amazon, their Phylogeny, and Aspects of Host-Parasite Coevolution*. Journal of the Helminthological Society of Washington, vol. 59, pp. 52-75.
- Vieira, DHMD, Caramello, LE, Abdallah, VD, Silva, RJD & Azevedo, RKD. 2013. *Community ecology of metazoan parasites of the sairú Cyphocharax nagelii from the Peixe River*. Revista Brasileira de Parasitologia Veterinária, vol. 22, pp.611-615.
- Vital, JF, Varella, AMB, Porto, DB & Malta, JCO. 2011. *Sazonalidade da fauna de metazoários de Pygocentrus nattereri (Kner, 1858) no lago Piranha (Amazonas, Brasil) e a avaliação de seu potencial como indicador da saúde do ambiente/Seasonality of the metazoan fauna of Pygocentrus nattereri (Kner, 1858) in Piranha Lake, (Amazonas, Brazil), and evaluation of its potential as an indicator of environmental health*. Biota Neotropica, vol. 11, pp.1-6.
- Weitzman, SH & Vari, RP. 1988. *Miniaturization in South American freshwater fishes; an overview and discussion*. Proceedings of the Biological Society of Washington, vol. 101, pp.444-465.
- Yamada, FH, Brandão, H, Yamada, P & Silva, RJ. 2015. *Philocorydorax longus sp. n.*

(Monogenea, Dactylogyridae) from the gills of Hoplosternum littorale (Siluriformes, Callichthyidae) in Southeastern Brazil and the reassignment of two species from the genus Urocleidoides to

Philocorydoras. Helminthologia, vol. 52, pp.331-335.

Received April 7, 2017.
Accepted August 6, 2017.