Checklist of parasites in fish from the upper Paraná River floodplain: An update

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Abstract
This study provides an updated list of parasite species and their respective hosts in the upper Paraná River floodplain. The list of parasites is structured by phylum, class, order and family, followed by a record of each host species. A total of 315 taxa of parasites were reported, of which 201 were identified at the species level. These 201 species comprise 3 Flagellata, 3 Myxozoa, 50 Monogenea, 43 Digenea, 40 Cestoda, 41 Nematoda, 8 Acanthocephala, 6 Copepoda, 5 Branchiura and 2 Pentastomida, arranged in 84 host fish species. This work carried out in the floodplain of the upper Paraná River contributes to the listing of parasite species and host interactions of the local ichthyofauna. Little is known about these communities and its riches are underestimated due to the high density of fish found in this region, highlighting the importance of conducting studies on the local fauna.

Keywords: Monogenea, Digenea, Cestoda, Nematoda, Acanthocephala, Crustacea.

Resumo
Este estudo fornece uma lista atualizada de espécies de parasitos e seus respectivos hospedeiros da planície de inundação do alto rio Paraná. A lista de parasitos está estruturada em filo, classe, ordem e família, seguida do registro de cada espécie de hospedeiro. São relatados 315 táxons de parasitos e, destes, 201 foram identificados por espécie. Essas 201 espécies compreendem: 3 Flagellata, 3 Myxozoa, 50 Monogenea, 43 Digenea, 40 Cestoda, 41 Nematoda, 8 Acanthocephala, 6 Copepoda, 5 Branchiura e 2 Pentastomida, distribuídos em 84 espécies de hospedeiros. Este trabalho, realizado na planície de inundação do alto rio Paraná, contribui para a listagem de espécies de parasitos e interações parasito-hospedeiro da ictiofauna local. Pouco dessas comunidades é conhecida, e suas riquezas são subestimadas devido à alta densidade de peixes encontrados nessa região, destacando-se a importância da realização de estudos sobre a fauna local.

Palavras-chave: Monogenea, Digenea, Cestoda, Nematoda, Acanthocephala, Crustacea.

Introduction
The Paraná River is the tenth longest river in the world in water discharge and it is located in south-central South America, running through Brazil, Paraguay and Argentina. The upper Paraná River floodplain is the only dam-free stretch remaining, located between the Porto Primavera and Itaipu dams (Agostinho et al., 2001). In this stretch, the river has a vast portion of wide-braided channels from numerous lagoons, whether permanent or temporary, which are distributed throughout the plain and are fed by groundwater or by the flooding process (Junk et al., 1989; Agostinho & Júlio, 1999; Thomaz et al., 2004).
The recurrent floods experienced by this ecosystem are an important selection pressure that favors certain adaptations in the organisms inhabiting this area, resulting in communities with unique structures and functions (Junk et al., 1989; Thomaz et al., 2007). One of the main characteristics of floodplain river systems in tropical and subtropical regions is the high diversity of species, particularly of fish (Horne & Goldman, 1994; Toussaint et al., 2016; Vitule et al., 2017). In this context, the high diversity of the environment can alter the population dynamics of the ichthyofauna, along with their ecological, physiological and biological conditions. This, in turn, influences the structure and composition of parasitic fauna in fish (Pavanelli et al., 1997; Yamada et al., 2008; Luque & Poulin, 2008; Locke et al., 2014), including the trophic category and the intermediate hosts of parasites (Landsberg et al., 1998).

The parasite fauna of fish from the upper Paraná River floodplain were previously detailed by Pavanelli et al. (1997), Takemoto et al. (2009) and further studies that reported taxonomic descriptions of new species, such as Ferrari-Hoeinghaus et al. (2010), Tavernari et al. (2010), Karling et al. (2011, 2014). Over the last decade, studies recorded in this area have indicated an increase in the diversity of fish parasites, so the purpose of this study was to provide an updated list of parasites and their respective fish hosts in the upper Paraná River floodplain.

Material and Methods

This study was conducted with data from published articles, dissertations, thesis, and research project reports (consult supplementary material) on parasites from fish carried only at the Laboratório de Ictioparasitologia of Universidade Estadual de Maringá between 1988 and 2019, in the region of the upper Paraná River floodplain (Figure 1).

The list of parasite species presented in this study is clustered by phylum and classified in class, order, and family. For Myxozoa and Flagellata, the classification is in accordance with Brusca et al. (2018a,b); for Monogenea,
Cohen et al. (2013); for Digenea, Thatcher (1993) and Kohn et al. (2007); for Cestoda, Khalil et al. (1994) and Vidal-Martínez et al. (2000); for Nematoda, Moravec (1998); for Acanthocephala, Yamaguti (1959) and Thatcher (2006); for Crustacea, Eiras et al. (2010), Ahyong et al. (2011) and Luque et al. (2013); and for Hirudinea and Acari, Brusca et al. (2018c,d). Some informative changes in recent literature, such as the World Register of Marine Species, have also been considered. When the species are unknown, the parasites were cataloged in class, family or genus, while the identified species are presented in alphabetical order, followed by the author and year of publication. For the hosts, the identification and registration of occurrence in the floodplain were checked and confirmed according to Ota et al. (2018), and these are listed opposite their respective parasites. Information about the parasite’s life stage and the infection site was also added.

For the quantification of interactions, all association formed between a given parasite and its host was considered. For parasites with more than one host, the number of interactions was added, taking into account all their respective hosts. We consider the most specific taxonomic level of the parasite, since all hosts are at the species level.

Results

In this study, 13 groups of parasites were registered for 84 species of ichthyofauna from the upper Paraná River floodplain, of which eight were groups of ectoparasites and six of endoparasites, with emphasis on the Pentastomida group considered for two types of parasitism. Three hundred and fifteen taxa were cataloged and 201 of these were identified at the species level. These 201 species comprise 3 Flagellata, 3 Myxozoa, 50 Monogenea, 43 Digenea, 40 Cestoda, 41 Nematoda, 8 Acanthocephala, 6 Copepoda, 5 Branchiura, and 2 Pentastomida. The parasites belonging to Isopoda, Hirudinea and Acari were identified only at the group level, but are added together in the interaction records.

The parasites of the Monogenea class had the largest number of identified species, totaling 50. However, the largest number of different interactions recorded, regardless of the level of identification (order, family, or larval stage, immature form), were the parasites of the phylum Nematoda with 227 interactions, followed by the Digenea subclass with 176 interactions, and then the Monogenea class with 149 interactions.

Parasite-Host List

FLAGELLATA

Phylum Euglenozoa Cavalier-Smith, 1981
Class Kinetoplastea Honigberg, 1963
Order Trypanosomatida (Kent, 1880)
Family Trypanosomatidae Doflein, 1901
Trypanosoma guairaensis Eiras, Rego & Pavanelli, 1989 - Megalancistrus parananus (Peters, 1881), blood.
Trypanosoma nupelianus Eiras, Rego & Pavanelli, 1990 - Rhinelepis aspera Spix & Agassiz, 1829, blood.
Trypanosoma scrofae Eiras & Pavanelli, 1989 - Prochilodus lineatus (Valenciennes, 1836), blood.

MYXOZOA
Phylum Cnidaria Hatschek, 1888
Class Myxozoa Grassé, 1970
Order Bivalvulida Shulman, 1959
Family Myxobolidae Thélohan, 1892
Henneguya caudicula Eiras, Takemoto & Pavanelli, 2008 - Leporinus lacustris Campos, 1945, spore, gills.
Henneguya coruscans Eiras, Takemoto & Pavanelli, 2009 - Pseudoplatusoma coruscans (Spix & Agassiz, 1829), spore, gills.
Henneguya paranaensis Eiras, Pavanelli & Takemoto, 2004 - Prochilodus lineatus, spore, gills.

MONOGENEA
Phylum Platyhelminthes Minot, 1876
Class Monogenea (Van Beneden, 1858)
Monogenea fam. gen. sp. - Acestorrhynchus lacustris Lütken, 1875, Aphyocharax anisitsi Eigenmann & Kennedy, 1903, Auchenipterus osteomystax (Miranda Ribeiro, 1918), Crenicichla sp., Geophagus brasiliensis (Quoy & Gaimard, 1825),...
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1824), Hypophthalmus oremaculatus Nani & Fuster, 1947, Hypostomus regani (Ihering, 1905), Hypostomus ternetzi (Boulenger, 1895), Iheringichthys labrosus (Lütken, 1874), Leporellus vittatus Valenciennes, 1850, Loricaria sp., Loricariichthys platymetopon Isbrücker & Nijssen, 1979, Parauchenipterus galeatus (Linnaeus, 1766), Piaractus mesopotamicus (Holmberg, 1887), Pimelodus maculatus (Lacépède, 1803), Plagioscion squamosissimus (Heckel, 1840), Potamotrygon amandae Loboda & Carvalho, 2013, Pseudoplatyostoma corrucans, Rhamdia quelen (Quoy & Gaimard, 1824), Rhaphiodon vulpinus Spix & Agassiz, 1829, Rhinelepis aspera, Roeboides descalvadensis Fowler, 1932, Salminus brasiliensis (Cuvier, 1816), Satanoperca sp., Schizodon nasutus Kner, 1858, Serrasalmus marginatus Valenciennes, 1837, Trachydoras paraguayensis (Eigenmann & Ward, 1907), gills.

Order Dactylogyridea Bychowsky, 1937
Family Dactylogyridae Bychowsky, 1933
Ameloblastella paranaensis (França, Isaac, Pavanelli & Takemoto, 2003) - Iheringichthys labrosus, gills.
Amphithecium sp. - Astyanax lacustris (Lütken, 1875), Schizodon borellii (Boulenger, 1900), Serrasalmus marginatus, gills.
Amphocleithrium sp. - Pseudoplatyostoma corrucans, gills.
Amphocleithrium paraguayensis Price & Romero, 1969 - Pseudoplatyostoma corrucans, gills.
Anacanthocotyle anacanthocotyle Kritsky & Fritts, 1970 - Astyanax lacustris, Moenkhausia forestii Benine, Mariguela & Oliveira, 2009, gills.
Anacanthoroides sp. - Prochilodus lineatus, gills.
Anacanthorus sp. - Erythrinus erythrinus (Bloch & Schneider, 1801), Hoplyrhythynus unitenaio (Agassiz, 1829), Hoplias spp., Metynnis lippincottianus (Cope, 1870), Salminus brasiliensis, Serrasalmus maculatus Kner, 1858, Serrasalmus marginatus, gills.
Anacanthorus bicuspidatus Cohen, Kohn & Boeger, 2012 - Salminus brasiliensis, gills.
Anacanthorus contortus Cohen, Kohn & Boeger, 2012 - Salminus brasiliensis, gills.
Anacanthorus douradensis Cohen, Kohn & Boeger, 2012 - Salminus brasiliensis, gills.
Anacanthorus perakruidenieri Cohen, Kohn & Boeger, 2012 - Salminus brasiliensis, gills.
Anacanthorus penilabiatus Boeger, Husak & Martins, 1995 - Piaractus mesopotamicus, gills.
Anacanthorus toledoensis Cohen, São Clemente & Leão, 2015 - Piaractus mesopotamicus, gills.
Ancyrocephalinae gen. sp. - Prochilodus lineatus, Pseudoplatyostoma corrucans, Schizodon borellii, Serrasalmus marginatus, gills.
Annulotreminatoes sp. - Schizodon borellii, gills.
Apedunculata sp. - Schizodon borellii, gills.
Characithecium costaricensis (Price & Bussing, 1967) - Moenkhausia forestii, gills.
Cleidodiscus sp. - Laetacara araguaiae Ottoni & Costa, 2009, Leporinus friderici Bloch, 1794, Leporinus lacustris, Megaleporinus piavussu (Britois, Birindelli & Garavello, 2012), Satanoperca sp., gills.
Cosmetocleithrum bulbocirrus Kritsky, Thatcher & Boeger, 1986 - Hoplias spp., gills.
Dactylogyridae gen. sp. - Hoplias spp., gills.
Demidospermus sp. - Auchenipterus osteomystax, Pimelodus maculatus, Serrasalmus marginatus, gills.
Demidospermus labrosi Monteiro, Kritsky & Brasil-Sato, 2010 - Iheringichthys labrosus, gills.
Demidospermus osteomystax Tavernari, Takemoto, Lacerda & Pavanelli, 2010 - Auchenipterus osteomystax, gills.
Demidospermus paranaensis Ferrari-Hoeinghaus, Bellay, Takemoto & Pavanelli, 2010 - Loricariichthys platymetopon, gills.
Diplectanum piscinarius Kritsky & Thatcher, 1984 - Plagioscion squamosissimus, gills.
Gussevia sp. - Astronotus crassipinnis (Heckel, 1840), gills.
Gussevia arilla Kritsky, Thatcher & Boeger, 1986 - Cichla kelberi Kullander & Ferreira, 2006, gills.
Gussevia asota Kritsky, Thatcher & Boeger, 1989 - Astronotus crassipinnis, gills.
Gussevia longihaptor (Mizelle & Kritsky, 1969) - Cichla kelberi, gills.
Gussevia rogersi Kritsky, Thatcher & Boeger, 1989 - Astronotus crassipinnis, gills.
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Gussevia undulata Kritsky, Thatcher & Boeger, 1986 - Cichla kelberi, Cichla piquiti Kulander & Ferreira, 2006, gills.
Gussevia tucunarense Kritsky, Thatcher & Boeger, 1986 - Cichla piquiti, gills.
Jainus sp. - Leporellus vittatus, Leporinus friderici, Leporinus lacustris, Megaleporinus piavussu, Moenkhausia aff. intermedia Eigenmann, 1908, Moenkhausia forestii, Salminus brasiliensis, Schizodon borelli, gills.
Jainus hexaps Kritsky & Leiby, 1972 - Moenkhausia forestii, Moenkhausia sanctaefilomenae (Steindachner, 1907), gills.
Jainus piva Karling, Bellay, Takemoto & Pavanelli, 2011 - Schizodon borelli, gills.
Kritskyia sp. - Megaleporinus obtusidens Valenciennes, 1836, Megaleporinus piavussu, swimming bladder and mesonephric duct.
Kritskyia annakohnae Boeger, Tanaka & Pavanelli, 2001 - Serrasalmus maculatus, Serrasalmus marginatus, ureters and urinary bladder.
Kritskyia boegeri Lizama, Takemoto & Pavanelli, 2002 - Prochilodus lineatus, urinary bladder.
Kritskyia eirasi Guidelli, Takemoto & Pavanelli, 2003 - Leporinus friderici, Leporinus lacustris, urinary bladder and mesonephric duct.
Kritskyia kritskyi Bellay, Takemoto, Yamada & Pavanelli, 2009 - Geophagus sveni Lucinda, Lucena & Assis, 2010, gills.
Kritskyia toksonum Lizama, Takemoto & Pavanelli, 2004 - Prochilodus lineatus, gills.
Notothecium sp. - Serrasalmus marginatus, gills.
Notozotheicum sp. - Serrasalmus marginatus, gills.
Omotheicum sp. - Pinirampus pirinampu (Agassiz, 1829), gills.
Pavanelliella pavanelli Kritsky & Boeger, 1998 - Pimelodus maculatus, nasal cavity and gills.
Rhinoastes pseudocapsaloideum Kritsky, Thatcher & Boeger, 1988 - Prochilodus lineatus, nasal cavity.
Rhinoxenus sp. - Megaleporinus macrocephalus (Garavello & Britski, 1988), Serrasalmus marginatus, gills.
Rhinoxenus arietinus Kritsky, Boeger & Thatcher, 1988 - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, nasal cavity and gills.
Rhinoxenus bulbovaginatus Boeger, Domingues & Pavanelli, 1995 - Salminus brasiliensis, nasal cavity.
Sciadicleithrum sp. - Crenicichla sp. gills.
Sciadicleithrum ergensi Kritsky, Thatcher & Boeger, 1989 - Cichla piquiti, gills.
Sciadicleithrum joanae Yamada, Takemoto, Bellay & Pavanelli, 2009 - Crenicichla britskii Kulander, 1982, gills.
Sciadicleithrum kritskyi Bellay, Takemoto, Yamada & Pavanelli, 2009 - Geophagus sveni Lucinda, Lucena & Assis, 2010, gills.
Sciadicleithrum paraenensis Bellay, Takemoto, Yamada & Pavanelli, 2009 - Geophagus sveni, gills.
Sciadicleithrum uncinatum Kritsky, Thatcher & Boeger, 1989 - Cichla piquiti, gills.
Tereancistrum sp. - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, Prochilodus lineatus, Schizodon borelli, gills.
Tereancistrum curimba Lizama, Takemoto & Pavanelli, 2004 - Prochilodus lineatus, gills.
Tereancistrum paranaensis Karling, Lopes, Takemoto & Pavanelli, 2014 - Schizodon borelli, gills.
Tereancistrum parvus Kritsky, Thatcher & Kayton, 1980 - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, Schizodon borelli, gills.
Tereancistrum toksonum Lizama, Takemoto & Pavanelli, 2004 - Prochilodus lineatus, gills.
Trinibaculum sp. - Schizodon borelli, gills.
Trinibaculum rotundus Karling, Lopes, Takemoto & Pavanelli, 2011 - Schizodon borelli, gills.
Unibarca sp. - Pimelodus maculatus, Pinirampus pirinampu, Pseudoplatystoma corruscans, gills.
Urocleidoides sp. - Astyanax lacustris, Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, Schizodon borelli, Steindachnerina insculpta (Fernández-Yépez, 1948), gills.
Urocleidoides brasiliensis Rosim, Mendoza-Franco & Luque, 2011 - Hoplias spp., gills.
Urocleidoides cuiabai Rosim, Mendoza-Franco & Luque, 2011 - Hoplias spp., gills.
Urocleidoides eremitus Kritsky, Thatcher & Boeger, 1986 - Hoplias spp., gills.
Urocleidoides malabaricus Rosim, Mendoza-Franco & Luque, 2011 - Hoplias spp., gills.
Urocleidoides paradoxus Kritsky, Thatcher & Boeger, 1986 - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, gills.

Vancleaveus sp. - Pseudoplatystoma corruscans, Trachydoras paraguayensis, gills.

Vancleaveus fungulus Kritsky, Thatcher & Boeger, 1986 - Pseudoplatystoma corruscans, gills.

Vancleaveus janauacaensis Kritsky, Thatcher & Boeger, 1986 - Hoplias spp., gills.

Family Gyrodactylidae Van Beneden & Hesse, 1863

Gyrodactylus sp. - Moenkhausia forestii, Prochilodus lineatus, gills and nasal cavity.

Gyrodactylus neotropicalis Kritsky & Fritts, 1970 - Astyanax lacustris, Moenkhausia forestii, gills.

DIGENEA

Phylum Platyhelminthes Minot, 1876

Class Trematoda Rudolphi, 1808

Subclass Digenea Carus, 1863

Digenea fam. gen. sp. - Crenicichla britskii, Cyphocharax modestus (Fernández-Yépez, 1948), Gymnatus inaequilibiatus (Valenciennes, 1839), Hoplerythrinus unitaeniatus, Laetacara araguaiae, Loricariichthys rostratus Reis & Pereira, 2000, Megaleporinus macrocephalus, Moenkhausia aff. intermedia, Moenkhausia forestii, Myloplus tiete (Eigenmann & Norris, 1900), Piniramrus pirinampu, Pseudoplatystoma corruscans, Rhamdia quelen, Synbranchus marmoratus Bloch, 1795, adult and metacercariae, mesentery, eyes, cranial cavity, gills, muscle, swimming bladder and kidney.

Order Diplostomida Olson, Cribb, Tkach, Bray & Littlewood, 2003

Family Diplostomidae Poier, 1886

Austrodiplostomum sp. - Cichla piquiti, Hemisorubim platyrhynchos (Valenciennes, 1840), Plagioscion squamosissimus, Rhinelepis aspera, Sorubim lima (Bloch & Schneider, 1801), metacercariae, eyes.

Austrodiplostomum compactum (Lutz, 1928) - Acestrorhynchus lacustris, Auchenipterus osteomystax, Cichla kelberi, Crenicichla britskii, Geophagus sveni, Hoplias spp., Hypostomus regani, Loricariichthys platymetopon, Pimelodus ornatus Kner, 1858, Plagioscion squamosissimus, Prochilodus lineatus, Pterygoplichthys ambrosettii (Holmberg, 1893), Satanoperca sp., Schizodon borelli, metacercariae, eyes.

Diplostomidae gen. sp. - Ageneiosus inermis (Linnaeus, 1766), Aphyocharax anisitsi, Auchenipterus osteomystax, Crenicichla sp., Cyphocharax nagelii (Steindachner, 1881), Geophagus sveni, Hoplias spp., Hypostomus regani, Loricariichthys platymetopon, Pimelodus ornatus Kner, 1858, Plagioscion squamosissimus, Prochilodus lineatus, Pterygoplichthys ambrosettii (Holmberg, 1893), Satanoperca sp., Schizodon borelli, metacercariae, eyes.

Diplostomum sp. - Cichla kelberi, Cyphocharax nagelii, Gymnatus spp., Hoplerythrinus unitaeniatus, Hoplias sp., Leporinus friderici, Parauchenipterus galeatus, Pimelodus maculatus, Steindacherina insculpta, metacercariae, eyes.

Neascus sp. - Crenicichla sp., metacercariae, encysted on the heart.

Neodiplostomum sp. - Gymnatus spp., Megaleporinus piavussu, metacercariae, visceral cavity.

Sphincterodiplostomum sp. - Cichla piquiti, Hemisorubim platyrhynchos, Prochilodus lineatus, Steindacherina brevipinna (Eigenmann & Eigenmann, 1889), metacercariae, eyes and visceral cavity.

Sphincterodiplostomum musculosum Dubois, 1936 - Hoplias spp., Steindacherina insculpta, metacercariae, eyes and visceral cavity.

Tylodelphis sp. - Astyanax lacustris, Cyphocharax nagelii, Gymnatus spp., Leporinus lacustris, Potamotrygon cf. Falkneri Castex & Maciel, 1963, Prochilodus lineatus, metacercariae, visceral cavity.

Family Proterodiplostomidae Dubois, 1936

Crocodilicola sp. - Auchenipterus osteomystax, Gymnatus spp., metacercariae, gonads.

Crocodilicola pseudostoma (Willemoes-Suhm, 1870) - Hemisorubim platyrhynchos, Loricariichthys platymetopon, adult, metacercariae and progenetic metacercariae, swimming bladder, visceral cavity and digestive tract.

Cystodiplostomum sp. - Leporinus lacustris, metacercariae, gonads.
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Herpetodiplostomum sp. - Astyanax lacustris, Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, metacercariae, swimming bladder.

Herpetodiplostomum gymnotti Szidat & Graefe, 1969 - Iheringichthys labrosus, metacercariae, mesentery and gonads.

Family Sanguinicolidae von Graff, 1907
Kritsky platyrhynchi (Guidelli, Issac & Pavanelli, 2002) - Hemisorubim platyrhynchos, adult, visceral cavity.
Sanguinicola sp. - Megaleporinus piavussu, Sorubim lima, adult, visceral cavity.
Sanguinicola coelomica (Szidat, 1951) - Pimelodus maculatus, adult, coelom.

Order Plagiorchiida La Rue, 1957
Family Acanthostomidae Poche, 1926
Acanthostomum gnerii Szidat, 1954 - Rhamdia quelen, adult, intestine.

Family Allocreadiidae Looss, 1902
Auriculostoma platense (Szidat, 1954) - Iheringichthys labrosus, Pimelodus maculatus, adult, intestine.
Crepidostomum platense Szidat, 1954 - Pimelodus maculatus, adult, stomach.
Crepotremata sp. - Leporinus lacustris, adult, intestine.
Crepotremata creptotrema Travassos, Artigas & Pereira, 1928 - Auchenipterus osteomystax, Leporellus vittatus, Leporinus friderici, Megaleporinus obtusidens, Pimelodus maculatus, adult, intestine.
Crepotremata lynchii Brooks, 1976 - Megaleporinus piavussu, adult, intestine.
Crepotrematina sp. - Moenkhausia forestii, adult, intestine.

Family Apocreadiidae Skrjabin, 1942
Crassicutis cichlasomae Manter, 1936 - Crenicichla sp., Geophagus brasiliensis, Loricaria sp., adult, intestine.
Crassicutis intermedius (Szidat, 1954) - Hypostomus regani, Hypostomus ternetzi, adult, intestine.

Family Bucephalidae Poche, 1907
Bucephalidae gen. sp. - Astyanax lacustris, eyes, brain, muscles and visceral cavity.
Prosorhynchus piranhus Thatcher, 1999 - Serrasalmus maculatus, adult, intestinal tract.
Rhipidocotyle gibsoni Kohn & Fernandes, 1994 - Acestrorhynchus lacustris, adult, intestine.
Rhipidocotyle jeffersoni (Kohn, 1970) - Salminus brasiliensis, adult, intestine.

Family Callodistomidae Odhner, 1910
Prosthenhystera sp. - Hoplias spp., adult, gall bladder.
Prosthenhystera obesa (Diesing, 1850) - Pimelodus maculatus, Salminus brasiliensis, adult, gall bladder.

Family Cladorchiidae Fischoeder, 1901
Colocladorchis sp. - Prochilodus lineatus, adult, intestine.
Colocladorchis ventrastomis Thatcher, 1979 - Prochilodus lineatus, adult, intestine.
Dadaytrema sp. - Megalancistrus parananus, adult, intestine.
Dadaytrema oxycephala (Diesing, 1836) - Brycon orbignyanus (Valenciennes, 1850), Piaractus mesopotamicus, Pseudoplatystoma corrucans, Pterodoras granulosus (Valenciennes, 1821), adult, intestine.
Dadaytremoides parauchenipteri (Lunaschi, 1989) - Ageneiosus inermis, adult and metacercariae, stomach and intestine.
Dadayius pacupeva Lacerda, Takemoto & Pavanelli, 2003 - Metynnis lippincottianus, adult, intestinal tract.

Family Cryptogonimidae Ciurea, 1933
Iheringtrema iheringi Travassos, 1948 - Zungaro jahu (Ihering, 1898), adult, intestine.
Parspina sp. - Iheringichthys labrosus, adult, intestine.
Pseudosellacotyla lutzi (Freitas, 1941) - Hoplias spp., adult, intestine.
Family Derogenidae Nicoll, 1910
Genarchella sp. - Potamotrygon cf. falkneri, adult, stomach.
Genarchella astyanactis (Watson, 1976) - Megaleporinus obtusidens, Plagioscion squamosissimus, adult, stomach.
Genarchella genarchella Travassos, Artigas & Pereira, 1928 - Megalancistrus parananus, Pimelodus ornatus, Potamotrygon amandae, adult, buccal cavity, oesophagus and stomach.
Thometrema overstreeti (Brooks, Mayes & Thorson, 1979) - Hoplias spp., Pimelodus maculatus, Salminus brasiliensis, adult, stomach.

Family Didymozoidae Monticelli, 1888
Didymozoidae gen. sp. - Moenkhausia forestii, eyes, brain, muscles and visceral cavity.

Family Echinostomatidae Looss, 1899
Echinostomatidae gen. sp. - Leporinus friderici, metacercariae, eyes, brain, muscles and visceral cavity.

Family Faustulidae Poche, 1926
Antorchis sp. - Astyanax lacustris, metacercariae, intestine.

Family Gorgoderidae Looss, 1899
Gorgoderidae gen. sp. - Hemisorubim platyrhynchos, adult, urinary bladder.

Family Haploporidae Nicoll, 1914
Chalcinotrema thatcheri Kohn, Fernandes & Gibson, 1999 - Leporinus lacustris, Schizodon nasutus, adult, intestine.
Lecithobothrioides sp. - Prochilodus lineatus, adult, intestine.
Megacoelium sp. - Megaleporinus piavussu, Prochilodus lineatus, adult, stomach.
Paralecithobothrys brasiliensis Freitas, 1948 - Leporinus friderici, Megaleporinus obtusidens, Megaleporinus piavussu, Schizodon borelli, Schizodon nasutus, adult, intestine.
Saccocoelioides sp. - Prochilodus lineatus, adult, pyloric caeca and intestine.
Saccocoelioides elongatus Sziat, 1954 - Prochilodus lineatus, adult, intestine.
Saccocoelioides godoyi Kohn & Froes, 1986 - Cyphocharax nagelii, Leporinus friderici, adult, intestine and stomach.
Saccocoelioides leporinodus Thatcher, 1978 - Prochilodus lineatus, adult, intestine.
Saccocoelioides magnivatellum Sziat, 1954 - Megaleporinus obtusidens, adult, pyloric caeca and stomach.
Saccocoelioides magnorchis Thatcher, 1978 - Prochilodus lineatus, adult, pyloric caeca, intestine and stomach.
Saccocoelioides magnus Sziat, 1954 - Leporinus lacustris, Megalancistrus parananus, Megaleporinus obtusidens, Schizodon nasutus, adult, intestine.
Saccocoelioides nanii Sziat, 1954 - Prochilodus lineatus, Rhaphiodon vulpinus, adult, intestine.
Saccocoelioides platensis Lunaschi, 1984 - Schizodon borelli, adult, intestine.
Saccocoelioides saccodontis Thatcher, 1978 - Leporinus friderici, Prochilodus lineatus, adult, pyloric caeca and intestine.
Unicoelium prochilodorum Thatcher & Dossman, 1975 - Prochilodus lineatus, adult, intestine.

Family Heterophyidae Odhner, 1914
Ascocotyle sp. - Astyanax lacustris, Cichla piquiti, Geophagus sveni, Moenkhausia forestii, Satanoperca sp., Serrasalmus marginatus, metacercariae, body musculature, heart, stomach, liver, kidney, spleen, gonads and mesentery.

Family Macroderoididae McMullen, 1937
Magnivitellinum corvitellinum Lacerda, Takemoto & Pavanelli, 2009 - Hoplosternum littorale (Hancock, 1828), adult, digestive tract.
Magnivitellinum simplex Kloss, 1966 - Roeboides descavaladensis, adult, intestine.

Family Microscaphidiidae Looss, 1900
Curumai curumai Travassos, 1961 - Piaractus mesopotamicus, adult, intestine.
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Family Opisthorthidae Braun, 1901
*Neododocystis intestinalis* (Vaz, 1932) - *Salminus brasiliensis*, adult, intestine.

Family Paramphistomidae Fischoeder, 1901
*Microchis oligovitellum* Lunaschi, 1987 - *Auchenipterus osteomystax, Parachenipterus galeatus*, adult, intestine.

**CESTODA**

**Phylum Platyhelminthes Minot, 1876**
**Class Cestoda Rudolphi, 1808**

*Cestoda fam. gen. sp.* - *Acestrorhynchus lacustris, Crenicichla jaguarensis* Haseman, 1911, *Galeocharax gulo* (Cope, 1870), *Gymnotus inaequiliobatus, Potamotrygon amandae, Piaractus mesopotamicus, Plagioscion squamosissimus, Sternoptygus macrurus* (Bloch & Schneider, 1801), *Salminus brasiliensis, Schizodon borellii*, plerocercoid and adult, digestive tract.

**Order Bothriocephalidea Kuchta, Scholz, Brabec & Bray, 2008**
**Family Bothriocephalidae Blanchard, 1849**
*Regobothrium microhamulinum* Scholz, Takemoto & Kuchta, 2017 - *Catathyridium jenynsii* (Gunther, 1862), *Ageneiosus uccayalensis* Castelnau, 1855, adult, intestine.
*Senga sp.* - *Ageneiosus inermis*, adult, intestine.

**Order Cyclophyllidea Van Beneden in Braun, 1900**
**Family Gryporhynchidae Spassky & Spasskaya, 1973**
*Valipora sp.* - *Crenicichla britskii, Pimelodus maculatus*, plerocercoid, gall bladder.
*Valipora campylancristrota* (Wedl, 1855) - *Prochilodus lineatus*, plerocercoid and adult, gall bladder.

**Order Onchoproteocephalidea Caira, Jensen, Waschenbach, Olson & Littlewood, 2014**
Onchoproteocephalidea gen. sp. - *Acestorhynchus lacustris, Aphyocharax anisitsi, Astyanax lacustris, Galeocharax gulo, Iheringichthys labrosus, Leporellus vitatus, Prochilodus lineatus, Psellogrammus kennedyi, Satanoperca* sp., *Serrasalmus maculatus, Steindachnerina insculpta*, plerocercoid and adult, digestive tract.

**Family Onchobothriidae Braun, 1900**
*Acanthobothrium regoi* Brooks, Mayes & Thorson, 1981 - *Potamotrygon amandae, Potamotrygon cf. falkneri*, adult, spiral valve.
*Ageneiella brevifilis* Chambrier & Vaucher, 1999 - *Ageneiosus inermis*, adult, intestine.
*Cangatiella arandasi* Pavanelli & Santos, 1991 - *Parachenipterus galeatus*, adult, intestine.
*Chambriella agostinhioi* (Pavanelli & Santos, 1992) - *Zungaro jahu*, adult, intestine.
*Chambriella itaipuensis* (Pavanelli & Rego, 1991) - *Hemisorubim platyrhynchos, Sorubim lima*, adult, intestine.
*Chambriella paraenaensis* (Pavanelli & Rego, 1989) - *Hemisorubim platyrhynchos*, adult, intestine.
*Choanoscolex abscissus* (Riggenbach, 1895) - *Pseudoplatystoma corruscans, Zungaro jahu*, adult, intestine.
*Gibsoniela sp.* - *Ageneiosus inermis*, adult, intestine.
*Gozeella nupeliensis* Pavanelli & Rego, 1991 - *Sorubim lima*, adult, intestine.
*Harriscolex kaparari* (Woodland, 1935) - *Pseudoplatystoma corruscans*, adult, intestine.
*Jauella glandicephala* Rego & Pavanelli, 1985 - *Zungaro jahu*, adult, intestine.
*Manaoisia braconnemocca* Woodland, 1935 - *Sorubim lima*, adult, intestine.
*Mariauxiella pimelodi* Chambrier & Rego, 1995 - *Pimelodus ornatus, Sorubim lima*, adult, intestine.
*Mariauxiella piscatorum* Chambrier & Vaucher, 1999 - *Hemisorubim platyrhynchos*, adult, intestine.
*Megathylocus brooksi* Rego & Pavanelli, 1985 - *Zungaro jahu*, adult, intestine.
*Megathylocus travassosi* Pavanelli & Santos, 1991 - *Pseudoplatystoma corruscans*, adult, intestine.
*Monticellia belavistensis* Pavanelli, Machado, Takemoto & Santos, 1994 - *Piaractus mesopotamicus*, adult, intestine.
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**Monticellia coryphicephala** (Monticelli, 1892) - *Salminus brasiliensis*, adult, intestine.

**Monticellia loyolai** Pavanelli & Santos, 1992 - *Pimelodus maculatus*, adult, intestine.

**Monticellia magna** (Rego, dos Santos & Silva, 1974) - *Pimelodus maculatus*, adult, intestine.

**Nomimoscolex sp.** - *Pimelodus maculatus*, adult, intestine.

**Nomimoscolex admonticellia** (Woodland, 1934) - *Pinirampus pirinampu*, adult, intestine.

**Nomimoscolex chubbi** Pavanelli & Takemoto, 1995 - *Gymnotus spp.*, *Gymnotus inaequilabiatus*, adult, intestine.

**Nomimoscolex perinticellia** Chambrier, Takemoto & Pavanelli, 2006 - *Pseudoplatystoma corruscans*, adult, intestine.

**Nomimoscolex sudobim** Woodland, 1935 - *Pseudoplatystoma corruscans*, adult, intestine.

**Nupelia portoricensis** Pavanelli & Rego, 1991 - *Hemisorubim platyrhynchos*, *Sorubim lima*, adult, intestine.

**Peltidocotyle rugosa** Diesing, 1850 - *Zungaro jahu*, adult, intestine.

**Potamotrygonocestus travassosi** Rego, 1979 - *Potamotrygon cf. falkneri*, adult, spiral valve.

**Proteocephalinae gen. sp.** - *Aphyocharax anisitsi*, *Galeocharax gulo*, *Iheringichthys labrosus*, *Moenkhausia forestii*, *Prochilodus lineatus*, *Satanoperca sp.*, *Serrasalmus maculatus*, *Steindachnerina insculpta*, plerocercoid and adult, digestive tract.

**Proteocephalus macrophallus** (Diesing, 1850) - *Cichla kelberi*, *Cichla piquiti*, adult, intestine.

**Proteocephalus microscopicus** (Woodland, 1935) - *Cichla kelberi*, *Cichla piquiti*, adult, intestine.

**Proteocephalus serrasalmus** Rego & Pavanelli, 1990 - *Serrasalmus maculatus*, adult, intestine.

**Proteocephalus vazzolerae** Pavanelli & Takemoto, 1995 - *Leporinus friderici*, *Leporinus lacustris*, *Piaractus mesopotamicus*, adult, intestine.

**Rudolphiella piranabu** (Woodland, 1934) - *Pinirampus pirinampu*, adult, intestine.

**Sciadocephalus megalodiscus** Diesing, 1850 - *Cichla kelberi*, *Cichla piquiti*, adult, intestine.

**Spasskyellina sp.** - *Pimelodus ornatus*, plerocercoid and adult, intestine.

**Spasskyellina mandi** Pavanelli & Takemoto, 1996 - *Pimelodus ornatus*, adult, intestine.

**Spasskyellina spinulifera** (Woodland, 1935) - *Ageneiosus inermis*, *Brycon orbignyanus*, *Pseudoplatystoma corruscans*, *Sorubim lima*, plerocercoid and adult, intestine.

**Spatulifer maringaensis** Pavanelli & Rego, 1989 - *Hemisorubim platyrhynchos*, *Sorubim lima*, adult, intestine.

**Travassiella avitellina** Rego & Pavanelli, 1987 - *Zungaro jahu*, adult, intestine.

**Order Rhinebothriidea Healy, Cairns, Jensen, Webster & Littlewood, 2009**

**Family Eutetrarhynchidae Guiart, 1927**

**Paroncomegas araya** (Woodland, 1934) - *Potamotrygon cf. falkneri*, adult, spiral valve.

**Family Rhinebothriidae Euzet, 1953**

**Rhinebothrium paratrygoni** Rego & Dias, 1976 - *Potamotrygon amandae*, *Potamotrygon cf. falkneri*, adult, spiral valve.

**NEMATODA**

**Phylum Nematoda Rudolphi, 1808**

Nematoda fam. gen. sp. - *Aphyocharax anisitsi*, *Crenicichla britskii*, *Hypophthalmus oremaculatus*, *Hypostomus regani*, *Moenkhausia forestii*, *Pinirampus pirinampu*, *Prochilodus lineatus*, *Rhamphichthys hahni* (Meinken, 1937), *Rhinodoras dorbignyi* (Kner, 1855), *Satanoperca sp.*, immature form and adult, digestive tract.

**Class Adenophorea Linstow, 1905**

**Order Enoplida Schuurmans, Stekhoven & Deconinck, 1933**

**Family Dioctophymatidae (Railliet, 1915)**

**Eustrongylides sp.** - *Acestrorhynchus lacustris*, *Cichla kelberi*, *Gymnotus spp.*, *Leptoplisternum pectorale* (Boulenger, 1895), *Megaeporus piavussu*, *Pimelodus maculatus*, *Serrasalmus maculatus*, *Sorubim lima*, immature form, mesentery, abdominal cavity, musculature, liver and gonads.
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Eustrongylides ignotus jägersköld, 1909 - Ageneiosus inermis, Hemisorubim platyrhynchos, Hoplias spp., Pseudoplatystoma corruscans, Serrasalmus maculatus, Salminus brasiliensis, Serrasalmus marginatus, immature form and adult, mesentery, abdominal cavity, musculature, gonads and liver.

**Family Trichuridae Rainilampy, 1915**
Capillariidae gen. sp. - Pseudoplatystoma corruscans, Serrasalmus maculatus, Serrasalmus marginatus, adult, intestine.
Capillostrongylidae sentinosa (Travassos, 1927) - Megaleporinus obtusidens, adult, pyloric caeca.
Paracapillaria piscicina (Travassos, Artigas & Pereira, 1928) - Hoplias spp., Salminus brasiliensis, adult, stomach and intestine.

**Class Secernentea (von Linstow, 1905)**
**Order Ascaridida Yamaguti, 1961**
**Family Anisakidae Skrjabin & Karokhin, 1945**
Anisakidae gen. sp. - Brycon hilarii Valenciennes, 1850, Loricaria sp., Megaleporinus obtusidens, Prochilodus lineatus, Salminus brasiliensis, immature form, intestine.
Contracaecum sp. - Acetorhynchus lacustris, Ageneiosus inermis, Astyanax lacustris, Brycon orbignyanus, Cichla kelberi, Cichla piquiti, Crenicichla sp., Galeocerax gulo, Gymnotus spp., Hemisorubim platyrhynchos, Hoplias spp., Iheringichthys labrosus, Leporinus friderici, Leporinus lacustris, Leporellus vitatus, Megaleporinus obtusidens, Megaleporinus piavussu, Metynnis lippincottianus, Moenkhausia forestii, Parauchenipterus galeatus, Pimelodus maculatus, Plagioscion squamosissimus, Prochilodus lineatus, Psellogrammus kennedyi, Pseudoplatystoma corruscans, Rhaphiodon vulpinus, Salminus brasilensis, Serrasalmus maculatus, Serrasalmus marginatus, Sorubim lima, immature form, abdominal cavity, mesentery and liver.
Goezia sp. - Ageneiosus military Valenciennes, 1836, Brycon orbignyanus, Hemisorubim platyrhynchos, Iheringichthys labrosus, Parauchenipterus galeatus, Piaractus mesopotamicus, Pimelodus maculatus, Rhaphiodon vulpinus, Serrasalmus piavussu, Sorubim lima, immature form and adult, stomach and intestine.
Goezia brasiliensis Moravec, Kohn & Fernandes, 1994 - Brycon hilarii, Pseudoplatystoma corruscans, adult, stomach and intestine.
Goezia breviceca Moravec, Kohn & Fernandes, 1994 - Brycon hilarii, Leporinus friderici, adult, stomach.
Goezia spinulosa (Diesing, 1839) - Hoplias spp., Leporinus friderici, Megaleporinus obtusidens, Megaleporinus piavussu, adult, stomach and pyloric caeca.
Hysterorythylacium sp. - Brycon orbignyanus, Crenicichla sp., Galeocerax gulo, Geophagus brasiliensis, Gymnotus spp., Hypophthalmus ormaculatus, Leporinus friderici, Piaractus mesopotamicus, Plagioscion squamosissimus, Rhaphiodon vulpinus, Salminus brasiliensis, Serrasalmus marginatus, immature form and adult, intestine.
Raphidascaris sp. - Prochilodus lineatus, adult, intestine and stomach.
Raphidascaris (Sprentascaris) sp. - Geophagus brasiliensis, Geophagus sveni, immature form, intestine.
Raphidascaris (Sprentascaris) hypostomi (Petter & Cassone, 1984) - Hypostomus ternetzi, adult, intestine.
Raphidascaris (Sprentascaris) lanfrediae Melo, Santos, Giese, Santos & Santos, 2011 - Ageneiosus inermis, adult, intestine.
Raphidascaris (Sprentascaris) mahneri (Petter & Cassone, 1984) - Loricaria sp., Loricariichthys platymetopon, Loricariichthys rostratus, Metynnis lippincottianus, adult, digestive tract.

**Family Acanthocephalidae Baird, 1853**
Brevimulticaecum sp. - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piavussu, Moenkhausia forestii, Potamotrygon cf. falkneri, immature form, abdominal cavity, intestine, stomach and liver.
Porrocaecum sp. - Hoplias spp., Megaleporinus obtusidens, immature form, swimming bladder.

**Family Atractidae Travassos, 1919**
Klossinemella sp. - Pimelodus maculatus, adult, intestine.
Rondonia rondoni Travassos, 1920 - Piaractus mesopotamicus, Pterodoras granulosus, Rhaphiodon vulpinus, Trachydoras paraguayanus, adult, intestine.
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**Family Cucullanidae Cobbold, 1864**

*Cucullanus* sp. - *Potamotrygon cf. falkneri, Rhaphiodon vulpinus, Serrasalmus maculatus, Serrasalmus marginatus, Zungaro jahu*, adult, intestine.

*Cucullanus (Cucullanus) brevispiculus* Moravec, Kohn & Fernandes, 1993 - *Ageneiosus inermis, Auchenipterus osteomyxast*, adult, intestine.

*Cucullanus (Cucullanus) pinnae pinnae* Travassos, Artigas & Pereira, 1928 - *Ageneiosus militaris, Hemisorubim platyrhynchos, Loricaria sp., Pimelodus maculatus, Pimelodus ornatus, Schizodon borelli, Sorubim lima, Zungaro jahu*, adult, intestine.

*Cucullanus (Cucullanus) pinnae pterodorasi* Moravec, Kohn & Fernandes, 1997 - *Piaractus mesopotamicus*, adult, intestine.

*Cucullanus (Cucullanus) pseudoplatystomae* Moravec, Kohn & Fernandes, 1993 - *Pseudoplatystoma corruscans*, adult, intestine.

*Cucullanus (Cucullanus) zungaro* Vaz & Pereira, 1934 - *Hemisorubim platyrhynchos, Zungaro jahu*, adult, intestine.

*Dichelyne (Cucullanellus) sp.* - *Parauchenipterus galeatus*, immature form, intestine.

*Dichelyne leporini* Petter, 1989 - *Leporinus friderici, Leporinus lacustris*, adult, intestine.

*Dichelyne pimelodi* Moravec, Kohn & Fernandes, 1997 - *Pimelodus maculatus*, adult, intestine.

*Seuratoidea gen. sp.* - *Zungaro jahu*, adult, digestive tract.

**Family Kathlaniidae Lane, 1914**

*Spectatus* sp. - *Piaractus mesopotamicus*, immature form, intestine.

**Family Quimperiidae Gendre, 1928**

*Neoparasazeratum travassosi* Moravec, Kohn & Fernandes, 1992 - *Piaractus mesopotamicus, Trachydoras paraguayensis*, adult, intestine.

**Order Oxyurida Chabaud, 1974**

**Family Pharyngodonidae Travassos, 1919**

*Cosmoxynema vianai* Travassos, 1949 - *Steindacherina insculpta*, adult, intestine.

*Cosmoxynemoides* sp. - *Cyphocharax nagelii, Trachydoras paraguayensis*, adult, intestine.

*Ichthyours* sp. - *Bryo orbignyanus, Sorubim lima*, adult, intestine.

*Ichthyours brasilienisi* Moravec, Kohn & Fernandes, 1992 - *Megalancistrus paranus, Plagioscion squamosissimus*, adult, intestine.

*Ichthyours laterifilamenta* Moravec, Kohn & Fernandes, 1992 - *Trachydoras paraguayensis*, adult, intestine.

*Oxyuroidea gen. sp. Pinirampus pirinampu*, adult, intestine.

*Parasynodontisia petterae* Moravec, Kohn & Fernandes, 1992 - *Rhinelepis aspera, Trachydoras paraguayensis*, adult, intestine.

*Spinoxurus oxydoras* Petter, 1994 - *Ageneiosus inermis, Metynnis lippincottianus*, adult, intestine.

*Travnema travnema* Pereira, 1938 - *Steindacherina insculpta*, adult, intestine.

**Order Spirurida Chitwood, 1933**

**Family Acuariidae Railliet, Henry & Sisoff, 1912**

*Acuariidae gen. sp.* - *Salminus brasiliensis*, immature form, mesentery.

**Family Camallanidae Railliet & Henry, 1915**

*Paracamallanus amazonensis* Ferraz & Thatcher, 1992 - *Hypophthalmus oremaculatus, Piaractus mesopotamicus, Plagioscion squamosissimus*, adult, intestine.

*Procamallanus* sp. - *Acestrorhynchus lacustris, Schizodon altoparanae* (Garavello & Britski, 1990), *Trachydoras paraguayensis*, adult, intestine.
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*Procamallanus* (*Procamallanus*) *annipetterae* Kohn & Fernandes, 1988 - *Hypostomus regani*, *Hypostomus ternetzi*, *Megalecanistrus parananus*, adult, intestine

*Procamallanus* (*Procamallanus*) *peraccuratus* Pinto, Fábio, Noronha & Rolas, 1976 - *Crenicichla* sp., *Geophagus brasiliensis*, *Hemisorubim platyrhynchos*, *Hoplias* spp., *Potamotrygon amandae*, adult, intestine and occasionally stomach.

*Procamallanus* (*Spirocamallanus*) sp. - *Auchenipterus osteomyxstax*, *Geophagus brasiliensis*, *Pimelodus maculatus*, *Pseudoplatystoma corruscans*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *amarali* Vas & Pereira, 1934 - *Leporinus friderici*, *Megaleporinus obtusidens*, *Megaleporinus piavussu*, *Schizodon borellii*, *Serrasalmus marginatus*, *Sorubim lima*, *Trachydoras paraguayensis*, adult, intestine and pyloric caeca.

*Procamallanus* (*Spirocamallanus*) *caballeroi* (Bashirullah, 1977) - *Astyanax lacustris*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *hilarii* Vaz & Pereira, 1934 - *Brycon orbignyanus*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *iheringi* Travassos, Artigas & Pereira, 1928 - *Leporinus friderici*, *Megaleporinus obtusidens*, *Schizodon borellii*, adult, intestine and pyloric caeca.

*Procamallanus* (*Spirocamallanus*) *inopinatus* Travassos, Artigas & Pereira, 1928 - *Ageneiosus inermis*, *Brycon orbignyanus*, *Crenicichla jaguarensis*, *Hoplias* spp., *Leporinus friderici*, *Megaleporinus obtusidens*, *Megaleporinus piavussu*, *Metynnis lipincottianus*, *Parauchenipterus galeatus*, *Potamotrygon amandae*, *Piaractus mesopotamicus*, *Schizodon borellii*, *Serrasalmus marginatus*, *Sorubim lima*, *Trachydoras paraguayensis*, adult, intestine and occasionally stomach.

*Procamallanus* (*Spirocamallanus*) *neocaballeroi* (Caballero-Deloya, 1977) - *Serrasalmus maculatus*, *Serrasalmus marginatus*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *paraguayensis* (Petter, 1990) - *Brycon orbignyanus*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *pimelodus* Pinto, Fábio, Noronha & Rolas, 1975 - *Iheringichthys labrosus*, *Pimelodus maculatus*, adult, intestine.

*Procamallanus* (*Spirocamallanus*) *rarus* Travassos, Artigas & Pereira, 1928 - *Cichla piquiti*, *Sorubim lima*, adult, intestine.

**Family Cystidicolidae** Skrjabin, 1946

*Cystidicoloides* sp. - *Leporinus friderici*, immature form, mesentery.

*Spinitectus* sp. - *Potamotrygon cf. falkneri*, adult, spiral valve.

*Spinitectus asperus* Travassos, Artigas & Pereira, 1928 - *Prochilodus lineatus*, adult, intestine.

**Family Gnathostomatidae** (Railliet, 1895)

*Anycrananthus schubarti* (Kohn, Gomes & Motta, 1968) - *Leporinus lacustris*, *Schizodon borellii*, adult, stomach and intestine.

*Echinocephalus* sp. - *Potamotrygon cf. falkneri*, adult, spiral valve.

*Spiroxys* sp. - *Astyanax lacustris*, *Gymnotus* spp., *Moenkhausia forestii*, *Serrasalmus marginatus*, immature form, abdominal cavity, mesentery and intestine.

**Family Guyanemidae** Petter, 1974

*Guyanema raphiodoni* Moravec, Kohn & Fernandes, 1993 - *Rhaphiodon vulpinus*, adult, intestine.

*Travassosnema travassosi paranaensis* Moravec, Kohn & Fernandes, 1993 - *Acestrorhynchus lacustris*, adult, abdominal cavity.

**Family Philometridae** Baylis & Daubney, 1926

*Philometra* sp. - *Pimelodus maculatus*, adult, gonads and intestine.

*Philometridae gen. sp.* - *Acestrorhynchus lacustris*, *Pseudoplatystoma corruscans*, *Serrasalmus maculatus*, *Serrasalmus marginatus*, adult, abdominal cavity.

**Family Rhabdochonidae** Skrjabin, 1946

*Johnstonmawsonia* sp. - *Auchenipterus osteomyxstax*, *Parauchenipterus galeatus*, adult, intestine.

*Rhabdochona acuminata* Molin, 1860 - *Auchenipterus osteomyxstax*, *Brycon orbignyanus*, adult, intestine.
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ACANTHOCEPHALA
Phylum Acanthocephala Köreuter, 1771
Acanthocephala fam. gen. sp. - Ageneiosus inermis, Ageneiosus ucoyalensis, Brycon orbignyanus, Cichlasoma paranaense
Kullander, 1983, Hypostomus cochliodon Kner, 1854, Hypostomus regani, Loricaria sp., Piaractus mesopotamicus, Pseudoplatystoma corruscans, Schizodon altoparanae, Schizodon nasutus, Serrasalmus maculatus, Serrasalmus marginatus, digestive tract.

Class Palaeacanthocephala Meyer, 1931
Order Echinorhynchida Southwell & MacFie, 1925
Family Echinorhynchidae Cobbold, 1876
Echinorhynchus sp. - Schizodon borellii, Serrasalmus marginatus, adult, intestine.
Echinorhynchus briconi Machado-Filho, 1959 - Brycon orbignyanus, adult, intestine.
Echinorhynchus salobrensis Machado-Filho, 1948 - Serrasalmus maculatus, adult, intestine.

Class Eoacanthocephala Van Cleve, 1936
Order Gyracanthocephala Van Cleave, 1920
Family Quadrigyridae Van Cleave, 1920
Quadrigyrus sp. - Aphyocharax anisitsi, Astyanax lacustris, Iheringichthys labrosus, Moenkhausia forestii, Prochilodus lineatus, Psellogrammus kenydiyi, Rhaphidion vulpinus, immature form and adult, intestine.
Quadrigyrus brasiliensis Machado Filho, 1941 - Hoplerythrinus unitaeniatus, Steindachnerina insculpta, adult, intestine.
Quadrigyrus machadoi Fábio, 1983 - Hoplias spp., Cichla kelberi, Gymnotus spp., Hemisorubim platyrhynchos, Pimelodus maculatus, Potamotrygon amandae, Potamotrygon cf. falkneri, Sorubim lima, immature form and adult, intestine.
Quadrigyrus torquatus Van Cleave, 1920 - Acertrychynchus lacustris, Leporinus lacustris, adult, intestine.

Class Neoechinorhynchida Southwell & MacFie, 1925
Family Neoechinorhynchidae Ward, 1917
Gorytocephalus sp. - Hypostomus ternetzi, adult, intestine.
Neoechinorhynchus sp. - Pimelodus maculatus, Plagioscion squamosissimus, adult, intestine.
Neoechinorhynchus curemai Noronha, 1973 - Prochilodus lineatus, adult, intestine and pyloric caeca.
Neoechinorhynchus prochilodorum Nickol & Thatcher, 1971 - Prochilodus lineatus, adult, intestine.
Octospiniferoides sp. - Brycon orbignyanus, adult, intestine.
Octospiniferoides incognita Schmidt & Huggins, 1973 - Leporinus lacustris, Schizodon borellii, Salminus brasiliensis, Brycon orbignyanus, adult, intestine.

HIRUDINEA
Phylum Annelida Lamarck, 1809
Class Clitellata Michaelsen, 1919
Order Rhynchobdellida Blanchard, 1894
Rhynchobdellida gen. sp. - Prochilodus lineatus, gills, mouth and fins.

Family Glossiphoniidae Vaillant, 1890
Helobdella sp. - Pimelodus maculatus, adult, gills, mouth and fins.

Family Piscicolidae Johnston, 1865
Myzobdella sp. - Pimelodus maculatus, adult, gills, mouth and fins.

CRUSTACEA
Branchiura
Phylum Arthropoda Siebold, 1848
Subphylum Crustacea Brünich, 1772
Class Ichthyostega Zrzavý, Hypša & Vlášková, 1997
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Subclass Branchiura Thorell, 1864
Order Arguloida Yamaguti, 1963
Argulus sp. - Leporinus friderici, Leporinus lacustris, Megaleporinus piauussu, adult, body surface, nasal cavity and gills.
Argulus pestifer Ringuelet, 1948 - Pseudoplatusystoma corruscans, adult, body surface.
Dolops sp. - Megaleporinus obtusidens, Megaleporinus piauussu, Salminus brasiliensis, Schizodon borellii, adult, body surface, nasal cavity and gills.
Dolops carvalhoi Lemos de Castro, 1949 - Pseudoplatusystoma corruscans, adult, body surface.
Dolops geayi Bouvier, 1897 - Prochilodus lineatus, adult, body surface.
Dolops longicauda Heller, 1857 - Salminus brasiliensis, adult, body surface and gills.
Dolops nana Lemos de Castro, 1950 - Leporinus friderici, Megaleporinus piauussu, Megaleporinus obtusidens, adult, body surface and gills.

Copepoda
Phylum Arthropoda Siebold, 1848
Subphylum Crustacea Brünnich, 1772
Class Copepoda Milne-Edwards, 1840
Copepoda fam. gen. sp. - Auchenipterus osteomystax, Eigenmannia trilineata López & Castello, 1966, Gymnotus sylvius Albert & Fernandes-Matioli, 1999, Moenkhausia forestii, Moenkhausia aff. intermedia, Satanoperca sp., nasal cavity and gills.

Order Cyclopoidea Burmeister, 1834
Family Ergasilidae von Nordmann, 1832
Ergasilidae gen. sp. - Astyanax lacustris, Auchenipterus osteomystax, Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piauussu, Pinirampus pirinampu, Prochilodus lineatus, Pseudoplatusystoma corruscans, adult, nasal cavity and gills.
Acusicola sp. - Astyanax lacustris, Prochilodus lineatus, adult, gills.
Amplexibranchius sp. - Megaleporinus piauussu, Prochilodus lineatus, adult, gills.
Brasergasilus sp. - Astyanax lacustris, adult, gills.
Ergasilus bryconis Thatcher, 1981 - Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piauussu, adult, gills.
Ergasilus jaraquensis Thatcher & Robertson, 1982 - Prochilodus lineatus, adult, gills.
Gamidactylus sp. - Piemelodus maculatus, Prochilodus lineatus, adult, nasal cavity.
Gamidactylus jaraquensis Thatcher & Boeger, 1984 - Prochilodus lineatus, adult, nasal cavity.
Gamispatulus schizodontis Thatcher & Boeger, 1984 - Leporinus friderici, Leporinus lacustris, Megaleporinus obtusidens, Megaleporinus piauussu, Piaractus mesopotamicus, Schizodon borellii, Serrasalmus maculatus, Serrasalmus marginatus, adult, nasal cavity.
Gamispinus diabolicus Thatcher & Boeger, 1984 - Piaractus mesopotamicus, adult, nasal cavity.
Miracetyma sp. - Prochilodus lineatus, adult, gills.
Rhinergasilus sp. - Prochilodus lineatus, adult, nasal cavity.
Rhinergasilus piranhus Boeger & Thatcher, 1998 - Acestrorhynchus lacustris, Serrasalmus maculatus, adult, nasal cavity.
Therodamas sp. - Piemelodus maculatus, adult, gills.
Vaigamus sp. - Astyanax lacustris, Piemelodus maculatus, adult, gills and nasal cavity.

Isopoda
Phylum Arthropoda Siebold, 1848
Subphylum Crustacea Brünnich, 1772
Class Malacostraca Latreille, 1802
Order Isopoda Latreille, 1817
Cymothooidea fam. gen sp. - Cichla kelberi, Galeolarax gulo, Hoplias spp., adult, gills.
Family Cymothoidae Leach, 1818
Telotha sp. - Pimelodus maculatus, adult, gills.

Pentastomida
Phylum Arthropoda Siebold, 1848
Subphylum Crustacea Brünich, 1772
Class Ichthyosstraça Zrzavý, Hypša & Vlášková, 1997
Subclass Pentastomida Diesing, 1836
Order Porocephalida Heymons, 1935
Family Sebekiidae Fain, 1961
Sebekia oxycephala Diesing, 1835 - Hoplias spp., larvae, body surface.

Family Subtriquetridae Fain, 1961
Subtriquetra subtriquetra (Diesing, 1836) - Sorubim lima, larvae, swimming bladder.

ACARI
Phylum Arthropoda Siebold, 1848
Class Arachnida Cuvier, 1812
Order Acari Leach, 1817
Acarina fam. gen. sp. - Geophagus sveni, Serrasalmus marginatus, adult, gills and body surface.

Discussion
Our results indicate an increase of 68% in the number of identified species in the study area and a reduction of 6% of the taxonomic groups when compared with Takemoto et al. (2009). This result may be linked to an increase in the number of studies using integrative taxonomy for the identification of parasite species in this environment (e.g. Gasques et al., 2016; Da Graça et al., 2018; Franceschini et al., 2018).

The Monogenea class presented the largest number of identified species, and this, possibly, occurred due to the number of studies that have been carried out with the group in the floodplain. The group’s richness has already been addressed by Takemoto et al. (2009), and our result can be explained by the identifications and descriptions carried out with the aid of technology, for example, use of molecular techniques, consequently, generating greater interest in the group, more studies and publications (Eiras et al., 2011).

Parasites belonging to the phylum Nematoda and to the subclass Digenea were the groups with the largest number of cataloged interactions, which may be associated with the fact that they exploit different hosts species in their life cycles (Esch et al., 2002; Poulin, 2002; Luque, 2004; Takemoto et al., 2009). In the Cestoda class, it was possible to observe a significant increase in the number of identified species and interactions with several hosts, which is in accordance with studies that classify the order Onchoproteocephalidae, for example. That study covers the largest number of parasites in freshwater fish species (Luque, 2004); however, studies on ecological and pathological aspects of their cycle are lacking (Pavanelli et al., 2013).

The species of the phylum Acanthocephala were found in low richness in this study. It is important to study these organisms because they are commonly used as bioindicators, due to their high capacity for absorbing trace elements (Taraschewski, 2000; Dos Reis et al., 2017). They have a large bioaccumulation capacity, especially due to the absence of a digestive system, which leads them to absorb the pre-digested nutrients through diffusion directly from the intestinal content of fish. In addition, the location of the parasite in the fish – as well as its developmental stage – can perform an important role in the bioaccumulation process (Nachev & Sures, 2016; Paller et al., 2016; Sures et al., 2017).

The Hirudinea subclass has few records of interactions and it is still debated whether they are ectoparasites or associated organisms (Richardson et al., 2015). However, they play an important role in acting as vectors of flagellated protozoa of the Trypanosomatidae family, which were recorded parasitizing different hosts in our study. Much has been discussed about the specificity of Trypanosoma spp. and future studies with descriptions of new species for new hosts, using molecular biology, can help to understand these important parasites (Marchiori & Martins, 2013).

The Myxozoa parasites recorded just three species parasitizing three different hosts, all native to the Paraná River. However, we can highlight here the importance of studying their hosts (vertebrates and invertebrates) more thoroughly, in association with these parasites, given that more recent studies have showed their life cycles with several hosts (Takemoto et al., 2009; Eiras & Adriano, 2013).
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The phylum Arthropoda represents the greatest diversity of parasite groups (Arguloida, Pentastomida, Copepoda, Isopoda and Acarina), with a wide diversity of sizes, shapes and strategies of parasitism. In most of the cases, they are ectoparasites and are found in the gills and external surface of fish (Arguloida, Isopoda and Acarina), and also in some cavities of the body, such as nostrils (Copepoda), while the parasites of the subclass Pentastomida can be found in internal organs such as the gas bladder (Eiras et al., 2010). Although there is a large number of studies with these different groups, there is a lack of ecological studies (Luque et al., 2013), and the data published in this work partly reflect the lack of interest in studies on these groups acting as parasites.

In relation to infected host species, there was an increase of 14% in studies on their parasitic fauna in relation to the previous work, which can be explained by the constant process of invasion of non-native species of fish. The floodplain is located between two large reservoirs that, despite favoring the development of the local and regional economy, have seriously affected the aquatic biota with the emergence of non-native species (Gois et al., 2015; Agostinho et al., 2016). Invasive fish may be hosted by parasites that are not present in the local biota, and when introduced to the site together with their hosts, they can increase competition and affect the parasitic composition of native fish. In addition, it is known that 45% of fish species (Ota et al., 2018) whose parasitic fauna have already been studied are not native to the floodplain.

The biological characteristics of parasites have revealed information about host ecology, biogeography and phylogeny (Gardner & Campbell, 1992; Raga et al., 2008), and have also provided indicators of current and historical ecological relationships (Aznar et al., 2001). Therefore, to understand the role of the parasite community in an ecosystem, it is necessary to have prior knowledge of the species that belong to it (Takemoto et al., 2009). Although the studies conducted in the upper Paraná River floodplain have contributed towards surveying the parasite species, the species richness is still underestimated because of the high diversity of fish and the small number of these studies on this community. This emphasizes the importance of the present survey for deepening knowledge about the local fauna.

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**Supplementary Material**
Supplementary material accompanies this paper.
Legenda S1. Supplementary Material: Articles.
This material is available as part of the online article from [http://www.scielo.br/RBPV](http://www.scielo.br/RBPV)