Diversity of parasites of fish from the Upper Paraná River floodplain, Brazil

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(With 2 figures)

Abstract

The aim of the present study was to provide a current survey of the species of parasites found in the Upper Paraná River floodplain, as well as to investigate which strategies and mechanisms used by parasites, are favored and which environmental factors influence the parasite community in the studied environments. During a seven-year period from February 2000 to September 2007, 3,768 fish belonging to 72 species were collected and analyzed for the purpose of studying the parasite fauna. A total of 337 species of parasites were reported, including 12 new descriptions: one myxosporid, *Henneguya paranaensis* Eiras, Pavanelli and Takemoto, 2004; eight monogeneans, *Kritskyia annakohnae* Boeger, Tanaka and Pavanelli, 2001; *Kritskyia boegeri* Takemoto, Lizama and Pavanelli, 2002; *Kritskyia eirasi* Guidelli, Takemoto and Pavanelli, 2003; *Demidospermus labrosi* França, Isaac, Pavanelli and Takemoto, 2003; *Demidospermus mandi* França, Isaac, Pavanelli and Takemoto, 2003; *Pseudovancleaveus paranaensis* França, Isaac, Pavanelli and Takemoto, 2003; *Tereancistrum curimba* Lizama, Takemoto and Pavanelli, 2004 and *Tereancistrum toksonum* Lizama, Takemoto and Pavanelli, 2004; two digeneans, *Sanguinicola platyrhynchi* Guidelli, Isaac and Pavanelli, 2002 and *Dadayius pacupeva* Lacerda, Takemoto and Pavanelli, 2003 and one cestode, *Nomimoscolex pertierrae* Chambrier, Takemoto and Pavanelli, 2005. In addition, several other species were reported for the first time in new hosts or in the floodplain. Monogeneans presented the highest number of species, followed by digeneans. The infection site with the highest species richness was the intestine, with 127 species.

Keywords: ichthyoparasites, biodiversity, helminthes, crustaceans, parasite ecology.

Diversidade dos parasitos de peixes da planície de inundação do Alto Rio Paraná, Brasil

Resumo

O objetivo do presente trabalho foi realizar um novo levantamento das espécies de parasitos encontradas na planície de inundação do Alto Rio Paraná, bem como investigar quais estratégias e mecanismos utilizados pelos parasitos são mais favorecidos e quais fatores ambientais estão influenciando a comunidade parasitária nos ambientes estudados. Durante o período de fevereiro de 2000 a setembro de 2007, 3.768 espécimes de peixes pertencentes a 72 espécies foram coletados e analisados, visando o estudo da fauna parasitária. Até o momento foram registradas, 337 espécies de parasitos, sendo 12 novas espécies: uma de mixosporídeo, *Henneguya paranaensis* Eiras, Pavanelli e Takemoto, 2004; oito de monogenéticos, *Kritskyia annakohnae* Boeger, Tanaka e Pavanelli, 2001; *Kritskyia boegeri* Takemoto, Lizama e Pavanelli, 2002; *Kritskyia eirasi* Guidelli, Takemoto e Pavanelli, 2003; *Demidospermus labrosi* França, Isaac, Pavanelli e Takemoto, 2003; *Demidospermus mandi* França, Isaac, Pavanelli e Takemoto, 2003; *Pseudovancleaveus paranaensis* França, Isaac, Pavanelli e Takemoto, 2003; *Tereancistrum curimba* Lizama, Takemoto e Pavanelli, 2004 e *Tereancistrum toksonum* Lizama, Takemoto e Pavanelli, 2004; duas de digenéticos, *Sanguinicola platyrhynchi* Guidelli, Isaac e Pavanelli, 2002 e *Dadayius pacupeva* Lacerda, Takemoto e Pavanelli, 2003 e uma de cestóide, *Nomimoscolex pertierrae* Chambrier, Takemoto e Pavanelli, 2005. Além dessas novas espécies, várias outras foram registradas pela primeira vez em novos hospedeiros ou na planície. O grupo dos monogenéticos foi o que apresentou maior número de espécies encontradas, seguido pelos digenéticos. O intestino foi o sítio de infecção que apresentou a maior riqueza, com 127 espécies.

Palavras-chave: ictioparasitos, biodiversidade, helmintos, crustáceos, ecologia de parasitos.

1. Introduction

Floodplains are ecosystems that experience recurrent floods, favoring certain adaptations of the organisms inhabiting them and resulting in the presence of communities with characteristic structures and functions (Junk, et al. 1989). Floods can alter the population dynamics of the ichthyofauna, as well as their physiological and biological conditions, thereby influencing the structure and composition of the parasite fauna. In addition, chemical and physical variables of the water such as dissolved oxygen, temperature and turbulence can contribute to the emergence and increases in the demography of some parasite species (Pavanelli et al., 1997).

Luque and Poulin (2008) reported that differences in the taxonomic diversification of the parasite assemblages of different fish species were mainly related to the environment (higher values in benthic-demersal species), trophic level (positive correlation) and temperature (positive correlation for all groups of parasites in freshwater fishes). Therefore, the Upper Paraná River floodplain, characterized by a wide variety of habitats and species, favors the occurrence of a great diversity of fish parasites.

Lizama et al. (2006a) and Yamada et al. (2007) found higher parasitism indexes of monogeneans and digeneans in open lagoons in the Upper Paraná River floodplain. The authors explain that the presence of morphological adaptations, such as eggs with adhesive appendices that allow for attachment to a substrate, could explain the higher number of monogeneans. Meanwhile, digeneans could be more prevalent in these environments due to the great quantity of intermediate hosts in open lagoons. Studying *Pseudoplatystoma corruscans* (Spix and Agassiz, 1829) and *Schizodon borelli* (Boulenger, 1900), Machado et al. (1995) observed that fish were more parasitized by cestodes in semi-lentic environments and by nematodes in lentic environments, probably because of the great variety of prey and availability of shelter.

The parasite fauna of fish from the Upper Paraná River floodplain was previously detailed by Pavanelli et al. (1997, 2004). The present study investigates which reproductive strategies and dispersion mechanisms are favored, and which environmental factors (internal and external) influence the parasite community. In addition, this paper complements previous studies presenting an updated list of species of parasites and hosts.

2. Materials and Methods

All fish were collected in the floodplain of the Upper Paraná River, Brazil, from February 2000 to September 2007. Fishes were captured using gill nets, and parasites were collected with the aid of a stereoscopic microscope. The eyes, skin, fins, gills, nostrils and mouth cavity of the selected individuals were studied for ectoparasites. The body cavity was opened to examine the liver, stomach, pyloric caeca, intestine and gonads microscopically for endoparasites (see Eiras et al., 2006). The literature used to identify the parasites included original descriptions. Quantitative information on the prevalence and intensity of infection by different parasites and on parasite community descriptors have been published previously for the following fish species: *Prochilodus lineatus* (Valenciennes, 1837) (Takemoto et al., 2002; Eiras et al., 2004; Lizama et al., 2004; 2005; 2006a, b); *Acestrorhynchus lacustris* (Lütken, 1875) (Carvalho et al., 2003); *Iheringichthys labrosus* (Lütken, 1874) (França et al., 2003); *Hemisorubim platyrhynchos* (Valenciennes, 1840) (Guidelli et al., 2003a); *Leporinus* spp. (Guidelli et al., 2003b; 2006); *Metynnis maculatus* (Kner, 1858) (= *M. lippincottianus*) (Lacerda et al., 2003); *A. lacustris, S. borellii, P. lineatus, Serrasalmus marginatus* Valenciennes, 1837 and *S. maculatus* Kner, 1858 (Lacerda et al., 2007); *Potamotrygon* spp. (Lacerda et al., 2008; 2009); *Hoplias* aff. *malabaricus* (Bloch, 1794), *Satanoperca pappaterra* (Heckel, 1840), *Plagioscion squamosissimus* (Heckel, 1840), *Crenicichla britskii* Kullander, 1982, *Cichla monoculus* Spix and Agassiz, 1831 (= *C. kelberi*) and *Cichlasoma paranaense* Kullander, 1983 (Aoyama et al., 2005); *P. squamosissimus* (Tavernari et al., 2005); *P. corruscans* (Chambrier et al., 2006); *Loricariichthys platymetopon* Isbrücker and Nijssen, 1979 (Ferrari et al., 2007); *S. papaterra* (Yamada et al., 2007) and *Cichla* spp. (Yamada et al., 2008).

3. Results

We collected and analyzed 3,768 fish belonging to 72 species. A total of 337 species of parasites were reported (Appendix 1), including the description of 12 new species: one myxosporid, *Henneguya paranaensis* Eiras, Pavanelli and Takemoto, 2004; eight monogeneans, *Kritskyia annakohnae* Boeger, Tanaka and Pavanelli, 2001; *K. boegeri* Takemoto, Lizama and Pavanelli, 2002; *K. eirasi* Guidelli, Takemoto and Pavanelli, 2003; *Demidospermus labrosi* França, Isaac, Pavanelli and Takemoto, 2003; *D. mandi* França, Isaac, Pavanelli and Takemoto, 2003; *Pseudovancleaveus paranaensis* França, Isaac, Pavanelli and Takemoto, 2003; *Tereancistrum curimba* Lizama, Takemoto and Pavanelli, 2004 e *T. toksonum* Lizama, Takemoto and Pavanelli, 2004; two digeneans, *Sanguinicola platyrhynchi* Guidelli, Isaac and Pavanelli, 2002 and *Dadayius pacupeva* Lacerda, Takemoto and Pavanelli, 2003 and one cestode, *Nomimoscolex pertierrae* Chambrier, Takemoto and Pavanelli, 2006.

In total, 12 groups of parasites were collected, mainly Platyhelminthes (Monogenea, Digenea and Cestoda) and Nematoda. Among the groups of parasites found, monogeneans presented the greatest number of species with 82 (Figure 1), including species that parasitized gills, nasal fossae and urinary bladder. Among digeneans and nematodes, which also presented high numbers of species, adults and larval forms were observed. Sixty-nine species of digeneans were recorded, with 28 reported as larvae.

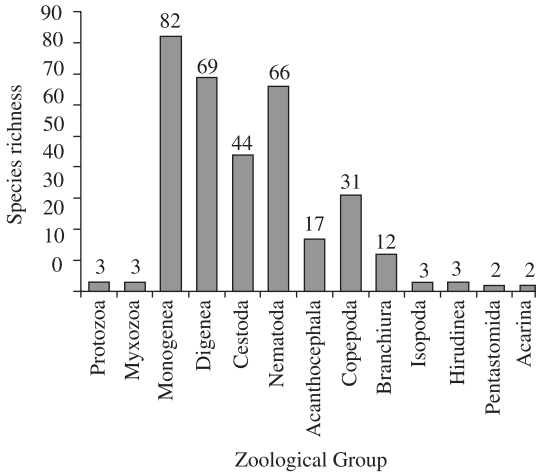

Figure 1. Species richness of fish parasites according to zoological group reported in the Upper Paraná River floodplain.

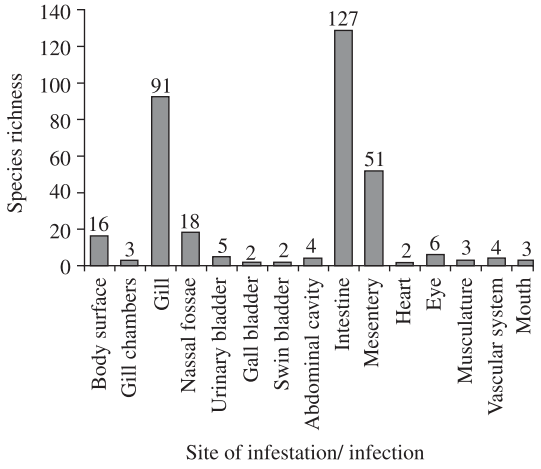

Figure 2. Species richness according to the site of infection/ infestation reported in the Upper Paraná River floodplain.

Nine out of 66 species of nematodes were larvae, and *Contracaecum* sp. (Anisakidae) was the most common.

The main infection site was the intestine, which was parasitized by 127 different species of parasites, including digeneans, cestodes, nematodes and acanthocephalans. These species were always found as adults (Figure 2). The gills presented the second highest number of species (91), mainly monogeneans and copepods. In the mesentery, the helminthes were mainly larval forms.

The parasitic protozoa are usually classified according to their motility mechanisms. These include amoeboid, flagellated, and ciliated forms. Among the protozoa, three species of Phylum Sarcomastigophora were reported: *Trypanosoma guairaensis* Eiras, Rego and Pavanelli, 1989, *T. scrofae* Eiras and Pavanelli, 1989 and *T. nupelianus* Eiras, Rego and Pavanelli, 1990, parasitizing *Megalancistrus parananus* (Peters, 1881), *P. lineatus* and *Rhineleps aspera* Spix and Agassiz, 1829, respectively.

The myxozoans, which until recently were considered protozoans, are now considered metazoans. The genus *Henneguya* was reported in the floodplain, with the description of a new species, *H. paranaensis* Eiras, Pavanelli and Takemoto, 2004.

During this period, the class Monogenea had the largest number of new species.

Digeneans presented the second highest number of species and low host specificity. Some species that parasitize fish in the larval stage, such as *Diplostomum* (*Austrodiplostomum*) *compactum* (Lutz, 1928) (probably introduced), were reported in nine different species of hosts: *H.* aff. *malabaricus, S. pappaterra, P. squamosissimus, C. britskii, Cichla kelberi* Kullander and Ferreira, 2006 (= *Cichla monoculus*)*, C. paranaense, Hypostomus regani* (Ihering, 1905)*, S. borellii,* and *Auchenipterus osteomystax* (Miranda Ribeiro, 1918).

Nematodes also generally have low host specificity, such as the nematode *Procamallanus* (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928, which was reported in nine different species of hosts (*S. marginatus, S. maculatus, S. borelli, H.* aff. *malabaricus, M. lippincottianus, Leporinus elongatus* Valenciennes, 1850*, L. obtusidens* (Valenciennes, 1837)*, L. lacustris* Amaral Campos, 1945 and *P. corruscans*) in the current study. However, Moravec (1998) had already registered this species in more than 40 species of fish from the Neotropical region. Another species of nematode that presented low specificity was the larvae of *Contracaecum* sp., which was already reported in 17 different species of hosts. This species deserves special attention because it parasitizes fish as larvae, using it as an intermediate host and then presenting zoonotic potential.

During this period only one species of cestode was described, *Nomimoscolex pertierrae* Chambrier, Takemoto and Pavanelli, 2006. In previous studies, the occurrence of this group was observed mainly in Siluriform fishes and with high host specificity. Considering only the fish "pintado", *P. corruscans* and "jaú", *Zungaro zungaro* (Humboldt, 1821) (= *Paulicea luetkeni*), six species of proteocephalideans were reported in each species, all adults. Larval stages of Cyclophyllidea were also reported, including *Valipora campylancristrota* (Wedl, 1855) in *P. lineatus, Pimelodus maculatus* Lacépède, 1803 and *Hoplosternum littorale* (Hancock, 1828), all parasitizing the gall bladder. In the stingrays *Potamotrygon motoro* (Müller and Henle, 1841) and *P. falkneri* Castex and Maciel, 1963, cestodes of orders Tetraphyllidea, *Acanthobothrium regoi* Mayes, Brooks and Thorson, 1981*, Rhinebothrium paratrygoni* Rego and Dias, 1976*, Potamotrygonocestus travassosi* Rego, 1979 and Trypanorhyncha, *Paroncomegas araya* (Woodland, 1934) were reported.

Among the acanthocephalans, *Quadrigyrus machadoi* Fabio, 1983 presented low specificity, occurring in seven different species of hosts (*P. motoro,*

P. falkneri, H. aff. *malabaricus, Gymnotus carapo* Linnaeus, 1758, *P. maculatus, H. platyrhynchos* and *C. kelberi*). Acanthocephalans of the genus *Quadrigyrus* occurred as adults and larvae.

The main families of Copepoda reported in the floodplain were Ergasilidae and Vaigamidae, parasitizing the branchial arcs and the nostrils, respectively. In addition, copepods of family Therodamasidae were observed parasitizing the branchial arcs of *P. maculatus*. This family is characterized by an anterior structure that penetrates into the tissues of the branchial arcs of the host, causing considerable lesions. This is the first record of this family in the Upper Paraná River floodplain.

Branchiura, Isopoda, Hirudinea, Pentastomida and Acarina presented low species diversity.

4. Discussion

In previous studies, Takemoto et al. (2004) reported 184 species of fish parasites in the Upper Paraná River floodplain. Currently, 337 species are known. This augmentation of species richness is due to the increase in the quantity of studies conducted in recent years, which have included different species of fish.

In addition to the previously described species, several other species were reported for the first time in the floodplain. In *P. maculatus*, for example, we reported the first copepods of the family Therodamasidae, and this is also the first record for the Upper Paraná River basin.

Myxozoa is a group of parasitic organisms for which the basic knowledge regarding phylogenetic affinities and life cycles has changed dramatically in the last two decades. The myxozoans were included as unicellular protozoans. However, according to Smothers et al. (1994) and Siddall et al. (1995), recent evidence clearly indicates that myxozoans are true metazoans. In the Upper Paraná River floodplain, only the genus *Henneguya* was observed.

Monogenea is the group that has presented the greatest number of species so far. Monogeneans are a diverse group of parasites that exhibit a relatively high degree of host specificity when compared to other groups of parasites. Because monogeneans do not represent a zoonotic problem for humans, and because most of them are not pathogenic, very little is known about the biology of most species (Bush et al., 2001).

The number of species recorded in this class tends to increase in the floodplain, since previous studies have already shown its high species richness in every species of host.

Among the groups of parasites found, digeneans presented the second highest number of species (69), including adults and larval stages. Some species of digeneans presented low specificity and were mainly present in larval forms. As an example we can cite *D.* (*A.*) *compactum,* a digenean that, in the metacercaria stage, parasitizes the eyes of fish. This parasite was probably introduced to the floodplain with *P. squamosissimus.* Despite being almost an obligatory parasite of this species, we noticed that in recent years, the number of species of parasitized hosts has increased considerably. We recorded this digenean in nine species of fish, showing low specificity and rapid adaptation to the new environment.

The conservation of the native fauna depends on research to increase knowledge regarding which parasites spread globally (Font, 2003). The goal of ecologists is not only to document the distribution of parasites, but also to determine methods by which parasites can disperse to new areas. Through the determination of the groups of parasites that can establish themselves in a new environment, it is possible to determine which strategies of reproduction are favored. Improved understanding of these mechanisms of dispersion can increase the chances of limiting the dispersion of certain parasites (Font, 2003).

Digeneans represent the highest number of species because fish can act as intermediate hosts, harboring larval stages, and also as definitive hosts, harboring adult forms. Moreover, the majorities of the fish examined here occupy intermediate levels in the food chain and can be parasitized by both forms.

Another larvae that showed low specificity was the nematode *Contracaecum* sp. This species belongs to the family Anisakidae and is of great importance in public health because of its high zoonotic potential. Anisakids are important to humans on a number of counts: economically, politically and mainly pathologically. Paratenic hosts are often fish that are important for human consumption. The worms do not mature in humans and the pathology is mostly associated with penetration of the small intestine and stomach by the larvae. The degree of discomfort is likely a consequence of the number of larvae penetrating. In rare cases, humans have died from anisakiasis due to severe peritonitis (Bush et al., 2001). However, there are no records of this zoonosis in the region and this is probably due to the fact that all of the larvae of this species were encysted in the mesentery, which is not used for human consumption.

The occurrence of a few species of some groups may be due to the absence or low number of certain hosts required for a particular stage of the developmental cycle. This is probably the case for the pentastomids that parasitize fish as larvae and alligators as adults. Although there are alligators in the floodplain, their numbers are relatively small when compared to other regions. The pentastomids are a small group of parasites that includes about 100 species. Studies on the phylogenetic relationships of the Pentastomida, a group traditionally treated as a separate phylum, suggest that they are truly arthropods with possible affinities for the crustacean (Bush et al., 2001).

The diversity of endohelminths can vary according to the environment or the species of host, and can be related to the size, longevity and particularly the food of the host. The intermediate host is necessarily part of the diet of the definitive host (Luque and Poulin, 2008). Furthermore, fish with a longer lifespan present more

time of exposure to parasites, favoring cumulative processes in the host.

In the Upper Paraná River floodplain, Takemoto et al. (2005) studied the effects of several host traits (body size, social behavior, reproductive behavior, spawning type, trophic category, feeding habits, relative position in the food web, preference for certain habitats and whether the fish species are native or exotic) on metazoan endoparasite species richness. The CPUE (number of individuals of a given fish species captured per 1,000 m^2 of net during 24 hours) was the sole significant predictor of parasite species richness, regardless of control for the confounding influences of host phylogeny and sampling effort. The results suggest that in the Upper Paraná River floodplain (with homogeneous physical characteristics and occurrence of many flood pulses), population density of different host species might be the major determinant of the parasite species richness. This result is in concordance with epidemiological theory predicting that hosts with larger or denser populations will more readily sustain several parasite populations. Because parasites in this study use fish as either intermediate or definitive hosts, depending on species, this situation might reflect a combination of large intermediate and definitive host populations facilitating parasite transmission and reproduction, respectively. However, it is important to mention that the cited study was developed utilizing data obtained from 1986 to 2003, and current floods pulses do not occur periodically as they used to because of the construction of several hydroelectric power plants upstream from the studied area.

To date, 182 species of fish have been registered in the Upper Paraná River floodplain (Graça and Pavanelli, 2007). If we assume that each species of host can harbor an average of ten species of parasites (Takemoto et al., 2004), there should be about 1,820 species of parasites in the floodplain. However, in the present study we recorded less than 350 species of parasites, with many more to be studied. This number, however, may be much higher, considering that in some hosts such as *P. lineatus*, 33 species of parasites were reported.

To understand the role of the community of parasites in an ecosystem, previous knowledge of the species that compose it is required. Continuation of studies using taxonomic and systematic approaches is the key to understanding how biotic and abiotic factors affect species, since there is no way to understand the effects on a population without knowing the species.

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Appendix 1. Species list of hosts (arranged by family) and parasites reported by Pavanelli et al. (1997, 2004) and the present work in the Upper Paraná River floodplain.

Species list

CHONDRICHTHYES
MYLIOBATIFORMES

Potamotrygonidae

• ***Potamotrygon motoro***
(Müller and Henle, 1841) (raia)
- Cestoda
  - *Acanthobothrium regoi* Mayes, Brooks and Thorson, 1981
  - *Rhinebothrium paratrygoni* Rego and Dias, 1976
- Acanthocephala
  - *Quadrigyrus machadoi* Fabio, 1983

• ***Potamotrygon falkneri***
Castex and Maciel, 1963 (raia)
- Digenea
  - *Clinostomum complanatum* Rudolphi, 1814 (metacercariae)
  - *Tylodelphis* sp. (metacercariae)
  - *Genarchella* sp.
- Cestoda
  - *Acanthobothrium regoi* Mayes, Brooks and Thorson, 1981
  - *Rhinebothrium paratrygoni* Rego and Dias, 1976
  - *Potamotrygonocestus travassosi* Rego, 1979
  - *Paroncomegas araya* (Woodland, 1934)
- Nematoda
  - *Brevimulticaecum* sp. (larvae)
  - *Cucullanus* sp.
  - *Echinocephalus* sp.
  - *Spinitectus* sp.
- Acanthocephala
  - *Quadrigyrus machadoi* Fabio, 1983

OSTEICHTHYES
CHARACIFORMES

Characidae

• ***Aphyocharax anisitsi***
Eigenmann and Kennedy, 1903 (piqui)
- Monogenea
- Digenea
  - Diplostomidae
- Cestoda
  - Proteocephalidea (plerocercoid)
- Nematoda
- Acanthocephala
  - *Quadrigyrus* sp.

• ***Psellogrammus kennedyi***
(Eigenmann, 1903) (lambari)
- Digenea
  - Diplostomidae
- Cestoda
  - Proteocephalidea (plerocercoid)
- Nematoda

Appendix 1. Continued...

Species list

- *Contracaecum* sp. (larvae)
- Acanthocephala
  - *Quadrigyrus* sp. (larvae)

• ***Serrapinus notomelas*** (Eigenmann, 1915) (pequira)
- Cysts

• ***Astyanax altiparanae***
Garutti and Britski, 2000 (tambiú)
- Monogenea
  - *Urocleidoides* sp.
  - *Amphithecium* sp.
- Digenea
  - *Clinostomum* sp. (metacercariae)
  - *Herpetodiplostomum* sp. (metacercariae)
  - *Tylodelphys* sp. (metacercariae)
  - *Ascocotyle* sp. (metacercariae)
  - *Antorchis* sp. (metacercariae)
  - Bucephalidae (metacercariae)
- Cestoda
  - Proteocephalidea (plerocercoid)
- Nematoda
  - *Procamallanus* (*Spirocamallanus*) *caballeroi* Bashirullah, 1977
  - *Contracaecum* sp. (larvae)
  - *Spiroxys* sp.
- Acanthocephala
  - *Quadrigyrus* sp.
- Copepoda
  - *Brasergasilus* sp.
  - *Ergasilus* sp.
  - *Vaigamus* sp.
  - *Acusicola* sp.

• ***Moenkhausia intermedia***
Eigenmann, 1908 (lambari)
- Digenea
- Copepoda

• ***Moenkhausia sanctaefilomenae***
(Steindachner, 1907) (lambari-do-olho-vermelho)
- Monogenea
  - *Jainus hexops* Kritsky and Leiby, 1972

• ***Roeboides descalvadensis*** Fowler, 1932 (dentudo)
- Digenea (metacercariae)
- Monogenea
  - *Jainus* sp.
  - *Demidospermus* sp.
- Acanthocephala
  - *Quadrigyrus* sp. (larvae)
- Copepoda

• ***Salminus brasiliensis*** (Cuvier, 1816) (dourado)
- Myxosporea
- Digenea
  - *Neocladocystis intestinalis* (Vaz,1932)
  - *Prosthenhystera obesa* (Diesing, 1850)
- Monogenea

Appendix 1. Continued...

Species list
Jainus sp.
Anacanthorus sp.
Rhinoxenus bulbovaginatus Boeger, Domingues and Pavanelli, 1995
Cestoda
Monticellia coryphicephala (Monticelli, 1891)
Nematoda
Eustrongylides ignotus Jäegerskiold, 1909 (larvae)
Anisakidae
Branchiura
Dolops longicauda (Heller, 1857)
Dolops sp.
• ***Acestrorhynchus lacustris*** (Lütken, 1875) (peixe-cachorro)
Monogenea
Digenea
Rhipidocotyle gibsoni Kohn and Fernandes, 1994
Clinostomum sp. (metacercariae)
Cestoda
Nematoda
Contracaecum sp. (larvae)
Procamallanus sp. (larvae)
Eustrongylides sp. (larvae)
Philometridae
Acanthocephala
Quadrigyrus torquatus Van Cleave, 1920
Copepoda
Rhinergasilus piranhus Boeger and Thatcher, 1988
• ***Galeocharax knerii*** (Steindachner, 1879) (peixe-cadela)
Cestoda
Proteocephalidea
Isopoda
• ***Brycon orbignyanus*** (Valenciennes, 1850) (piracanjuba)
Nematoda (larvae)
Serrasalmidae
• ***Serrasalmus marginatus*** Valenciennes, 1837 (piranha)
Monogenea
Kritskyia annakohnae Boeger, Tanaka and Pavanelli, 2001
Rhinoxenus sp.
Anacanthorus sp.1
Anacanthorus sp.2
Anacanthorus sp.3
Amphithecium sp.
Digenea
Ascocotyle sp. (metacercariae)
Nematoda
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928

Appendix 1. Continued...

Species list
Cucullanus sp.
Eustrongylides ignotus Jäegerskiold, 1909 (larvae)
Philometridae
Capilariidae
Acanthocephala
Copepoda
Gamispatulus schizodontis Thatcher and Boeger, 1984
Acarina
• ***Serrasalmus maculatus*** Kner, 1858 (piranha)
Monogenea
Kritskyia annakohnae Boeger, Tanaka and Pavanelli, 2001
Digenea
Prosorhynchus piranhus Thatcher, 1999
Cestoda
Proteocephalus serrasalmus Rego and Pavanelli, 1990
Nematoda
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Cucullanus sp.
Eustrongylides ignotus Jäegerskiold, 1909 (larvae)
Philometridae
Capilariidae
Acanthocephala
Copepoda
Gamispatulus schizodontis Thatcher and Boeger, 1984
• ***Myloplus* cf. *tiete*** Eigenmann and Norris, 1900 (pacu-prata)
Digenea
• ***Metynnis lippincottianus*** (Cope, 1870) (pacu-peva)
Digenea
Dadayius pacupeva Lacerda, Takemoto and Pavanelli, 2003
Nematoda
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Spinoxyuris oxydoras Petter, 1994
Raphidascaris (*Sprentascaris*) *mahnerti* (Petter and Cassone, 1984)
Contracaecum sp.
• ***Piaractus mesopotamicus*** (Holmberg, 1887) (pacu)
Digenea
Dadaytrema oxycephala (Diesing, 1836)
Cestoda
Proteocephalus vazollerae Pavanelli and Takemoto, 1995
Nematoda
Rondonia rondoni Travassos, 1920
Acanthocephala

Appendix 1. Continued...

Species list

Anostomidae

• ***Leporellus vittatus*** (Valenciennes, 1850) (solteira)
Monogenea
Jainus sp.
Digenea
Creptotrema creptotrema
Travassos, Artigas and Pereira, 1928
Cestoda
Proteocephalidea (plerocercoid)
Nematoda
Contracaecum sp.

• ***Leporinus macrocephalus***
Garavello and Britski, 1988 (piaussú)
Monogenea
Rhinoxenus sp.
Digenea (metacercariae)

• ***Leporinus friderici*** (Bloch, 1794) (piau)
Monogenea
Cleidodiscus sp.
Tereancistrum parvus
Kritsky, Thatcher and Kayton, 1980
Tereancistrum sp.
Urocleidoides paradoxus
Kritsky, Thatcher and Boeger, 1986
Urocleidoides sp.
Jainus sp.
Kritskyia eirasi
Guidelli, Takemoto and Pavanelli, 2003
Rhinoxenus arietinus
Kritsky, Boeger and Thatcher, 1988
Digenea
Creptotrema creptotrema
Travassos, Artigas and Pereira, 1928
Diplostomum sp. (metacercariae)
Echinostomatidae (metacercariae)
Herpetodiplostomum sp. (metacercariae)
Paralecithobotrys brasiliensis Freitas, 1947
Saccocoelioides saccodontis Thatcher, 1978
Cestoda
Proteocephalus vazzolerae
Pavanelli and Takemoto, 1995
Nematoda
Brevimulticaecum sp. (larvae)
Contracaecum sp. (larvae)
Cystidicoloides sp. (larvae)
Dycheline leporini Petter, 1989
Goezia brevicaeca
Moravec, Kohn and Fernandes, 1994
Goezia spinulosa (Diesing, 1839)
Hysterothylacium sp. (larvae)
Procamallanus (*Spirocamallanus*) *amarali*
Vaz and Pereira, 1934
Procamallanus (*Spirocamallanus*) *iheringi*
Travassos, Artigas and Pereira, 1928
Procamallanus (*Spirocamallanus*) *inopinatus*
Travassos, Artigas and Pereira, 1928

Appendix 1. Continued...

Species list

Branchiura
Argulus sp.
Dolops nana Lemos de Castro, 1950
Copepoda
Gamispatulus schizodontis
Thatcher and Boeger, 1984
Vaigamidae

• ***Leporinus elongatus*** Valenciennes, 1850 (piau)
Monogenea
Tereancistrum parvus
Kritsky, Thatcher and Kayton, 1980
Tereancistrum sp.
Urocleidoides paradoxus
Kritsky, Thatcher and Boeger 1986
Urocleidoides sp.
Jainus sp.
Kritskyia sp.
Rhinoxenus arietinus
Kritsky, Boeger and Thatcher, 1988
Digenea
Creptotrema creptotrema
Travassos, Artigas and Pereira, 1928
Herpetodiplostomum sp. (metacercariae)
Paralecithobotrys brasiliensis Freitas, 1947
Saccocoelioides magniovatus Szidat, 1954
Nematoda
Brevimulticaecum sp. (larvae)
Capillostrongyloides sentinosa
(Travassos, 1927)
Contracaecum sp. (larvae)
Goezia spinulosa (Diesing, 1839)
Porrocaecum sp. (larvae)
Procamallanus (*Spirocamallanus*) *amarali*
Vaz and Pereira, 1934
Procamallanus (*Spirocamallanus*) *iheringi*
Travassos, Artigas and Pereira, 1928
Procamallanus (*Spirocamallanus*) *inopinatus*
Travassos, Artigas and Pereira, 1928
Branchiura
Dolops nana Lemos de Castro, 1950
Dolops sp.
Copepoda
Ergasilus bryconis Thatcher, 1981
Gamispatulus schizodontis
Thatcher and Boeger, 1984
Vaigamidae

• ***Leporinus obtusidens***
(Valenciennes, 1837) (piapara)
Monogenea
Cleidodiscus sp.
Tereancistrum parvus
Kritsky, Thatcher and Kayton, 1980
Tereancistrum sp.
Urocleidoides paradoxus
Kritsky, Thatcher and Boeger, 1986
Urocleidoides sp.

Appendix 1. Continued...

Species list
Jainus sp.
Kritskyia sp.
Rhinoxenus arietinus Kritsky, Boeger and Thatcher, 1988
Digenea
Creptotrema lynchi Brooks, 1976
Herpetodiplostomum sp. (metacercariae)
Megacoelium sp.
Neodiplostomum sp. (metacercariae)
Paralecithobotrys brasiliensis Freitas, 1947
Nematoda
Brevimulticaecum sp. (larvae)
Contracaecum sp. (larvae)
Eustrongylides sp. (larvae)
Goezia spinulosa (Diesing, 1839)
Procamallanus (*Spirocamallanus*) *amarali* Vaz and Pereira, 1934
Procamallanus (*Spirocamallanus*) *iheringi* Travassos, Artigas and Pereira, 1928
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Branchiura
Argulus sp.
Dolops nana Lemos de Castro, 1950
Dolops sp.
Copepoda
Ergasilus bryconis Thatcher, 1981
Gamispatulus schizodontis Thatcher and Boeger, 1984
Amplexibranchius sp.
Vaigamidae
• ***Leporinus lacustris*** Amaral Campos, 1945 (corró)
Monogenea
Cleidodiscus sp.
Tereancistrum parvus Kritsky, Thatcher and Kayton, 1980
Tereancistrum sp.
Urocleidoides paradoxus Kritsky, Thatcher and Boeger, 1986
Urocleidoides sp.
Jainus sp.
Kritskyia eirasi Guidelli, Takemoto and Pavanelli, 2003
Rhinoxenus arietinus Kritsky, Boeger and Thatcher, 1988
Digenea
Chalcinotrema thatcheri Kohn, Fernandes and Gibson, 1999
Clinostomum complanatum Rudolphi, 1814 (metacercariae)
Creptotrema sp.
Cystodiplostomum sp.(metacercariae)
Herpetodiplostomum sp. (metacercariae)
Saccocoelioides magnus Szidat, 1954
Tylodelphis sp. (metacercariae)

Appendix 1. Continued...

Species list
Cestoda
Proteocephalus vazzolerae Pavanelli and Takemoto, 1995
Nematoda
Ancyracanthus schubarti Kohn, Gomes and Motta, 1968
Brevimulticaecum sp. (larvae)
Contracaecum sp. (larvae)
Dycheline leporini Petter, 1989
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Acanthocephala
Octospiniferoides incognita Schmidt and Hugghins, 1973
Quadrigyrus torquatus Van Cleave, 1920
Branchiura
Argulus sp.
Copepoda
Ergasilus bryconis Thatcher, 1981
Gamispatulus schizodontis Thatcher and Boeger, 1984
Vaigamidae
• ***Schizodon borelli*** (Boulenger, 1900) (piava)
Digenea
Ithyoclinostomum dimorphum (Diesing, 1850)
Clinostomum sp. (metacercariae)
Saccocoelioides platensis Lunaschi, 1984
Paralecithobotrys brasiliensis Freitas, 1947
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928)
Monogenea
Jainus sp.
Urocleidoides sp.
Tereancistrum sp.
Nematoda
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Procamallanus (*Spirocamallanus*) *iheringi* Travassos, Artigas and Pereira, 1928
Cucullanus pinnai Travassos, Artigas and Pereira, 1928
Ancyracanthus schubarti Kohn, Gomes and Motta, 1968
Acanthocephala
Octospiniferoides incognita Schmidt and Hugghins, 1973
Echinorhynchus sp.
Copepoda
Gamispatulus schizodontis Thatcher and Boeger, 1984
Branchiura
Dolops sp.
• ***Schizodon altoparanae*** Garavello and Britski, 1990 (piava)
Nematoda

Appendix 1. Continued...

Species list
Procamallanus sp.
Acanthocephala
• ***Schizodon nasutus*** Kner, 1858 (piava)
Monogenea
Curimatidae
• ***Cyphocharax nagelii*** (Steindachner, 1881) (saguiru)
Digenea
Diplostomum sp. (metacercariae)
Tylodelphis sp. (metacercariae)
• ***Cyphocharax modestus*** (Fernández-Yépez, 1948) (saguiru)
Digenea (metacercariae)
• ***Steindachnerina insculpta*** (Fernández-Yépez, 1948) (saguiru)
Monogenea
Urocleidoides sp.
Digenea
Diplostomum sp. (metacercariae)
Nematoda
Travnema travnema Pereira,1938
Cosmoxynema vianai Travassos, 1949
Prochilodontidae
• ***Prochilodus lineatus*** (Valenciennes, 1837) (curimba)
Protozoa
Trypanosoma scrofae Eiras and Pavanelli, 1989
Myxosporea
Henneguya paranaensis Eiras, Pavanelli and Takemoto, 2004
Monogenea
Rhinonastes pseudocapsaloideum Kritsky, Thatcher and Boeger, 1988
Kritskyia boegeri Takemoto, Lizama and Pavanelli, 2002
Tereancistrum curimba Lizama, Takemoto and Pavanelli, 2004
Tereancistrum toksonum Lizama, Takemoto and Pavanelli, 2004
Tereancistrum sp.
Gyrodactylus sp.1
Anacanthoroides sp.
Ancyrocephalinae
Digenea
Saccocoelioides magnorchis Thatcher, 1978
Saccocoelioides nanii Szidat, 1954
Unicoelium prochilodorum Thatcher and Dossman, 1975
Megacoelium sp.
Saccocoelioides leporinodus Thatcher, 1978
Saccocoelioides saccodontis Thatcher, 1978
Saccocoelioides sp.
Tylodelphis sp. (metacercariae)
Colocladorchis sp.
Sphinterodiplostomum sp. (metacercariae)

Appendix 1. Continued...

Species list
Lecitobothrioides sp.
Digenea (metacercariae)
Cestoda
Proteocephalidea (plerocercoid)
Valipora campylancristrota (Wedl, 1855)
Nematoda
Raphidascaris sp.
Acanthocephala
Neoechinorhynchus curemai Noronha, 1973
Quadrigyrus sp.
Copepoda
Gamidactylus jaraquensis Thatcher and Boeger, 1984
Gamispatulus sp.
Amplexibranchius sp.
Ergasilus sp.
Branchiura
Dolops geayi (Bouvier, 1897)
Hirudinea
Erythrinidae
• ***Hoplias* aff. *malabaricus*** (Bloch, 1794) (traíra)
Digenea
Clinostomum complanatum Rudolphi, 1814 (metacercariae)
Prosthenhystera sp.
Ithyoclinostomum dimorphum (Diesing, 1850) (metacercariae)
Diplostomum sp. (metacercariae)
Diplostomum (*Tylodelphys*) sp.1 (metacercariae)
Diplostomum (*Tylodelphys*) sp.2 (metacercariae)
Pseudosellacotyla lutzi (Freitas, 1941)
Sphincterodiplostomum musculosum Dubois, 1936 (metacercariae)
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928) (metacercariae)
Thometrema overstreeti (Brooks, Mayes and Thorson, 1979)
Nematoda
Eustrongylides ignotus Jäegerskiold, 1909 (larvae)
Contracaecum sp. (larvae)
Porrocaecum sp. (larvae)
Paracapillaria piscicola (Travassos, Artigas and Pereira, 1928)
Procamallanus (*Procamallanus*) *peraccuratus* Pinto, Fábio, Noronha and Rolas, 1976
Procamallanus (*Spirocamallanus*) *inopinatus* Travassos, Artigas and Pereira, 1928
Goezia spinulosa (Diesing, 1839)
Acanthocephala
Quadrigyrus machadoi Fábio, 1983
Pentastomida
Sebekia oxycephala Sambon, 1922
Isopoda

Appendix 1. Continued...

Species list

• ***Hoplerythrinus unitaeniatus***
(Spix and Agassiz, 1829) (jejú)
Digenea (metacercariae)
Nematoda
Acanthocephala
Quadrigyrus brasiliensis Machado, 1941

Cynodontidae
• ***Rhaphiodon vulpinus***
Agassiz, 1829 (dourado-cachorro)
Nematoda
Contracaecum sp. (larvae)
Acanthocephala
Quadrigyrus sp. (larvae)

GYMNOTIFORMES

Gymnotidae
• ***Gymnotus carapo*** Linnaeus, 1758 (morenita)
Digenea
Clinostomum complanatum
Rudolphi, 1814 (metacercariae)
Herpetodiplostomum sp. (metacercariae)
Crocodilicola sp.
Neodiplostomum sp. (metacercariae)
Tylodelphys sp. (metacercariae)
Cestoda
Nomimoscolex chubbi
(Pavanelli and Takemoto 1995)
Nematoda
Spiroxys sp.
Hysterothylacium sp. (larvae)
Contracaecum sp. (larvae)
Eustrongylides sp. (larvae)
Acanthocephala
Quadrigyrus machadoi Fábio, 1983

• ***Gymnotus inaequilabiatus***
(Valenciennes, 1839) (morenita)
Digenea
Cestoda

• ***Gymnotus sylvius***
Albert and Fernandes-Matioli, 1999 (morenita)
Copepoda

Sternopygidae
• ***Eigenmannia trilineata***
López and Castello, 1966 (Espadinha)
Copepoda

Rhamphichthyidae
• ***Rhamphichthys hahni***
(Meinken, 1937) (peixe-espada)
Nematoda

SILURIFORMES

Doradidae
• ***Pterodoras granulosus*** (Valenciennes, 1821)
(abotoado)
Digenea
Dadaytrema oxycephala (Diesing, 1836)

Appendix 1. Continued...

Species list

Cestoda
Monticellia belavistensis
Pavanelli, Santos and Takemoto, 1994
Nematoda
Rondonia rondoni Travassos, 1920
Acanthocephala

• ***Rhinodoras dorbignyi*** (Kner, 1855) (armado)
Nematoda

• ***Trachydoras paraguayensis***
(Eigenmann and Ward, 1907) (armadinho)
Monogenea
Vancleaveus sp.
Digenea
Strigeoidea (metacercariae)
Nematoda
Procamallanus sp.
Cosmoxynemoides sp.

Auchenipteridae
• ***Auchenipterus osteomystax***
(Miranda Ribeiro, 1918) (surumanha)
Monogenea
Demidospermus sp.
Digenea
Diplostomum (*Austrodiplostomum*) *compactum*
(Lutz, 1928) (metacercariae)
Creptotrema creptotrema
Travassos, Artigas and Pereira, 1928
Microrchis oligovitellum Lunaschi, 1987
Crocodilicola sp.
Clinostomum complanatum Rudolphi, 1814
(metacercariae)
Strigeidae (metacercariae)
Nematoda
Procamallanus (*Spirocamallanus*) sp.
Johnstonmawsonia sp.
Rhabdochona acuminata (Molin, 1860)
Copepoda

• ***Parauchenipterus galeatus***
(Linnaeus, 1766) (cangati)
Monogenea
Digenea
Microrchis oligovitelum Lunaschi, 1987
Clinostomum complanatum
Rudolphi, 1814 (metacercariae)
Cestoda
Cangatiella arandasi
Pavanelli and Machado dos Santos, 1991
Nematoda
Cucullanellus sp.
Goezia sp.

Ageneiosidae
• ***Ageneiosus brevifilis*** Valenciennes, 1840 (manduvê)
Cestoda
Gibsoniela mandube (Woodland, 1935)

Appendix 1. Continued...

Species list

Nematoda

• ***Ageneiosus ucayalensis*** Castelnau, 1855 (manduvê)
Acanthocephala

Pimelodidae

• ***Pseudoplatystoma corruscans***
(Spix and Agassiz, 1829) (pintado)
Myxosporea
Monogenea
Pavanelliella pavanellii
Kritsky and Boeger, 1998
Amphocleithrium paraguayensis
Price and Gonzalez Romero 1969
Amphocleithrium sp.
Vancleaveus fungulus
Kritsky, Thatcher and Boeger, 1986
Vancleaveus sp.
Unibarra sp.
Ancyrocephalinae
Digenea
Cestoda
Nomimoscolex sudobim Woodland, 1935
Nomimoscolex pertierrae
Chambrier, Takemoto and Pavanelli, 2006
Choanoscolex abscissus (Riggenbach, 1896)
Spasskyelina spinulifera (Woodland, 1935)
Harriscolex kaparari (Woodland, 1935)
Megathylacus travassosi
Pavanelli and Rego, 1992
Nematoda
Contracaecum sp.
Cucullanus (*Cucullanus*) *pseudoplatystomae*
Moravec, Kohn and Fernandes, 1993
Eustrongylides ignotus
Jäegerskiold, 1909 (larvae)
Procamallanus (*Spirocamallanus*) sp.
Philometridae
Acanthocephala
Branchiura
Dolops carvalhoi Lemos de Castro, 1949
Argulus pestifer Ringuelet, 1948
Copepoda
Ergasilidae
Vaigamidae

• ***Pimelodus maculatus*** Lacepède, 1803 (mandi)
Monogenea
Demidospermus sp.
Unibarra sp.
Pavanelliella pavanellii
Kritsky and Boeger, 1998
Digenea
Thometrema overstreeti
(Brooks, Mayes and Thorson, 1979)
Crepidostomum platense Szidat, 1954
Creptotrema creptotrema
Travassos, Artigas and Pereira, 1928
Plehniella coelomica Szidat, 1951

Appendix 1. Continued...

Species list

Prosthenhystera obesa (Diesing,1850)
Clinostomum sp. (metacercariae)
Diplostomum sp. (metacercariae)
Cestoda
Monticellia loyolai
Pavanelli and Machado dos Santos, 1992
Nomimoscolex sp.
Valipora sp.
Nematoda
Cucullanus pinnai
Travassos, Artigas and Pereira, 1928
Spirocamallannus sp.
Philometra sp.
Monhysterides sp.
Goezia sp.
Contracaecum sp. (larvae)
Eustrongylides sp. (larvae)
Acanthocephala
Neoechinorhynchus sp.
Quadrigyrus machadoi Fábio, 1983
Copepoda
Ergasilus sp.
Vaigamus sp.
Therodamas sp.
Gamidactylus sp.
Hirudinea
Helobdela sp.
Myzobdella sp.
Isopoda
Telotha sp.

• ***Pimelodus ornatus*** Kner, 1858 (mandi)
Cestoda
Mariauxiella pimelodi
Chambrier and Rego, 1995
Spasskyelina sp.

• ***Hemisorubim platyrhynchos***
(Valenciennes, 1840) (jurupoca)
Digenea
Crocodilicola pseudostoma
(Willemoes-Suhm, 1870)
Sanguinicola platyrhynchi
Guidelli, Isaac and Pavanelli, 2002
Sphincterodiplostomum sp.
Gorgoderidae
Cestoda
Goezeella paranaensis
Pavanelli and Rego, 1989
Spatulifer maringaensis
Pavanelli and Rego, 1989
Chambriella itaipuensis
(Pavanelli and Rego, 1991)
Mariauxiella piscatorum
Chambrier and Vaucher, 1999
Nematoda
Contracaecum sp. (larvae)

Appendix 1. Continued...

Species list
Cucullanus (*Cucullanus*) *zungaro* Vaz and Pereira, 1934
Eustrongylides ignotus Jägerskiöld, 1909 (larvae)
Goezia sp.
Acanthocephala
Quadrigyrus machadoi Fábio, 1983
Pentastomida
• ***Iheringichthys labrosus*** (Lütken, 1874) (mandi)
Monogenea
Demidospermus labrosi França, Isaac, Pavanelli and Takemoto, 2003
Demidospermus mandi França, Isaac, Pavanelli and Takemoto, 2003
Pseudovancleaveus paranaensis França, Isaac, Pavanelli and Takemoto, 2003
Digenea
Herpetodiplostomum sp. (metacercariae)
Cestoda
Proteocephalidea
Nematoda
Procamallanus (*Spirocamallanus*) *pimelodus* Pinto, Fábio, Noronha and Rolas, 1974
Contracaecum sp.
Acanthocephala
Quadrigyrus sp.
• ***Rhamdia quelen*** (Quoy and Gaimard, 1824) (bagre)
Digenea (metacercariae)
• ***Pinirampus pirinampu*** (Spix and Agassiz, 1829) (barbado)
Monogenea
Omothecium sp.
Unibarra sp.
Digenea (metacercariae)
Cestoda
Nomimoscolex admonticelia (Woodland, 1934)
Rudolphiella piranabu (Woodland, 1934)
Nematoda (larvae)
Copepoda
Vaigamidae
• ***Sorubim lima*** (Bloch and Schneider, 1801) (chinelo)
Cestoda
Spatulifer maringaensis Pavanelli and Rego, 1989
Paramonticellia itaipuensis Pavanelli and Rego, 1991
Nupelia portoriquensis Pavanelli and Rego, 1991
Goezeella nupeliensis Pavanelli and Rego, 1991
• ***Zungaro zungaro*** (Humboldt, 1821) (jaú)
Cestoda
Travassiella avitellina Rego and Pavanelli, 1987

Appendix 1. Continued...

Species list
Peltidocotyle rugosa Diesing, 1850
Megathylacus brooksi Rego and Pavanelli, 1985
Jauella glandicephalus Rego and Pavanelli, 1985
Chambriella agostinhoi Pavanelli and Santos, 1992
Choanoscolex abscissus (Riggenbach, 1895)
Nematoda
Cucullanus sp.
Hypophthalmidae
• ***Hypophthalmus edentatus*** Spix and Agassiz, 1829 (mapará)
Nematoda
Callichthyidae
• ***Hoplosternum littorale*** (Hancock, 1828) (tamboatá)
Digenea
Clinostomum complanatum Rudolphi, 1814 (metacercariae)
Loricariidae
• ***Loricariichthys platymetopon*** Isbrücker and Nijssen, 1979 (cascudo-chinelo)
Monogenea
Digenea
Clinostomum complanatum Rudolphi, 1814 (metacercariae)
Crocodilicola pseudostoma (Willemoes-Suhm, 1870) (metacercariae)
Nematoda
Raphidascaris (*Sprentascaris*) *mahnerti* (Petter and Cassone, 1984)
• ***Loricariichthys rostratus*** Reis and Pereira, 2000 (cascudo-chinelo)
Digenea (metacercariae)
• ***Hypostomus regani*** (Ihering, 1905) (cascudo-chita)
Digenea
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928) (metacercariae)
• ***Rhinelepis aspera*** Spix and Agassiz, 1829 (cascudo-preto)
Protozoa
Trypanosoma nupelianus Eiras, Rego and Pavanelli, 1990
• ***Megalancistrus parananus*** (Peters, 1881) (cascudo-abacaxi)
Protozoa
Trypanosoma guairaensis Eiras, Rego and Pavanelli, 1989
Hirudinea
SYNBRANCHIFORMES
Synbranchidae
• ***Synbranchus marmoratus*** Bloch, 1795 (mussum)
Digenea

Appendix 1. Continued...

Species list
PERCIFORMES
Sciaenidae
• ***Plagioscion squamosissimus*** (Heckel, 1840) (curvina)
Monogenea
Diplectanum piscinarius Kritsky and Thatcher, 1984
Digenea
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928) (metacercariae)
Nematoda (larvae)
Cichlidae
• ***Geophagus proximus*** (Castelnau, 1855) (acará)
Monogenea
Sciadicleithrum sp.1
Sciadicleithrum sp.2
Digenea
Ascocotyle sp. (metacercariae)
Nematoda
Raphidascaris (*Sprentascaris*) sp.
Acarina
• ***Satanoperca pappaterra*** (Heckel, 1840) (acará)
Monogenea
Cleidodiscus sp.
Sciadicleithrum sp.
Digenea
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928) (metacercariae)
Ascocotyle sp. (metacercariae)
Cestoda
Proteocephalidea (plerocercoid)
Nematoda
Copepoda
• ***Cichla kelberi*** Kullander and Ferreira, 2006 (tucunaré)
Monogenea
Gussevia arilla Kritsky, Thatcher and Boeger, 1986
Gussevia longihaptor (Mizelle and Kritsky, 1969)
Gussevia undulata Kritsky, Thatcher and Boeger, 1986
Digenea
Clinostomum sp. (metacercariae)

Appendix 1. Continued...

Species list
Diplostomum (*Austrodiplostomum*) *compactum* (Lutz, 1928) (metacercariae)
Diplostomum sp. (metacercariae)
Cestoda
Proteocephalus macrophalus (Diesing, 1850)
Proteocephalus microscopicus (Woodland, 1935)
Sciadocephalus megalodiscus Diesing, 1850
Nematoda
Contracaecum sp. (larvae)
Acanthocephala
Quadrigyrus machadoi Fábio, 1983 (larvae)
Isopoda
• ***Astronotus crassipinnis*** (Heckel, 1840) (oscar)
Monogenea
Gussevia asota Kritsky, Thatcher and Boeger, 1989
Gussevia astronoti Kritsky, Thatcher and Boeger, 1989
Gussevia rogersi Kritsky, Thatcher and Boeger, 1989
Gussevia sp.
• ***Crenicichla britskii*** Kullander, 1982 (joaninha)
Monogenea
Sciadicleithrum sp.
Digenea
Cestoda
Valipora sp.
Nematoda
• ***Crenicichla niederleinii*** (Holmberg, 1891) (joaninha)
Monogenea
Sciadicleithrum sp.
Digenea
Nematoda
• ***Cichlasoma paranaense*** Kullander, 1983 (cará)
Acanthocephala
• ***Laetacara* sp.** (cará)
Monogenea
Cleidodiscus sp.
Digenea