



Parasites in Loricariidae from Brazil: checklist and new records for fish from the Brazilian Amazon

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ABSTRACT. The aim of this study was to investigate the parasites fauna of *Ancistrus leucostictus*, *Hypostomus ventromaculatus*, *Ancistrus* sp. and *Hemiancistrus* sp. from the Igarapé Fortaleza River (Amapá State, Brazil), besides making a checklist of the parasite species in Loricariidae from Brazil. A total of 53 fishes were collected from November 2013 to August 2014. In the hosts, a total of 1,559 parasites of seven taxa were collected: *Unilatus unilatus*, *Trinigyryus mourei*, undetermined metacercariae, *Genarchella gernachella*, *Raphidascaris* (*Sprentascaris*) sp., *Gorythocephalus elongorchis* and *Proteocephalus* sp. Ectoparasite species were frequent in the examined Loricariidae species, which also had larval stages of endoparasites. The hosts with the highest sampled number, *H. ventromaculatus* and *Ancistrus* sp., had the highest parasite species richness. Loricariidae species from Brazil are parasitized by species of Protozoa, Monogenea, Nematoda, Digenea, Acantocephala, Cestoda, Crustacea and Hirudinea, but monogeneans, digeneans and nematodes were the predominant taxa.

Keywords: armored catfish ectoparasites; freshwater fish; Loricariidae.

Parasitos de Loricariidae do Brasil: checklist e novos registros para peixes da Amazônia brasileira

RESUMO. O objetivo deste estudo foi descrever a fauna parasitária de *Ancistrus leucostictus*, *Hypostomus ventromaculatus*, *Ancistrus* sp. e *Hemiancistrus* sp. da bacia Igarapé Fortaleza (Estado do Amapá, Brasil), além de fazer um checklist das espécies de parasitos em Loricariidae do Brasil. Foram coletados 53 peixes de novembro de 2013 a agosto de 2014. Nos hospedeiros foram coletados um total de 1.559 parasitos distribuídos em sete táxons: *Unilatus unilatus*, *Trinigyryus mourei*, metacercárias não identificadas, *Genarchella gernachella*, *Raphidascaris* (*Sprentascaris*) sp., *Gorythocephalus elongorchis* e *Proteocephalus* sp. Espécies de ectoparasitos foram frequentes nas espécies de Loricariidae examinadas, que também apresentaram estágios larvais de endoparasitos. Hospedeiros com maior número amostral, *H. ventromaculatus* e *Ancistrus* sp., apresentaram maior riqueza de espécies de parasitos. Espécies de Loricariidae do Brasil são parasitados por espécies de Protozoa, Monogenea, Nematoda, Digenea, Acantocephala, Cestoda, Crustacea e Hirudinea, mas monogeneas, digeneas e nematoides são os táxons predominantes.

Palavras-chave: cascudos; ectoparasitos; peixes de água doce; Loricariidae.

Introduction

Loricariidae is the most species-rich of freshwater fishes, with more than 915 valid species, distributed in 106 genera and six subfamilies (Lithogeneinae, Neoplecostominae, Ancistrinae, Hypoptopomatinae, Hypostominae and Loricariinae) and occurs in Costa Rica, Panama and South America (Alonso, Terán, Aguilera, & Mirande, 2016; Nelson, Grande, & Wilson, 2016). However, the highest occurrence of Loricariidae species is in the Amazon River basin system (Soares et al., 2011). Fish species of this family have size

ranging from 2.5 to 61.0 cm and detritivorous feeding habit, since they feed on debris, algae and invertebrates associated with the sediments of water bodies (Soares et al., 2011). Some species of Loricariidae such as *Ancistrus leucostictus* Günther, 1864; *Ancistrus* Rafinesque, 1815, *Hypostomus ventromaculatus* Boeseman, 1968 and *Hemiancistrus* Bleeker, 1862 are known for the Igarapé Fortaleza, a tributary of the Amazon River in the State of Amapá, eastern Amazon region (Brazil), the locality of this study. Loricariid species are fish that occupy a lower position in the food chain (Soares et al., 2011), thus they have a low parasitic fauna (Gonçalves, Oliveira, Santos, & Tavares-Dias, 2014).

Parasites play an important role in ecosystems, since they can regulate the abundance of host fish populations, destabilize food chains and alter the structure of communities of hosts (Luque & Poulin, 2007; Lagrue, Kelly, Hicks, & Poulin, 2011; Cardoso, Oliveira, Neves & Tavares-Dias, 2017; Baia, Florentino, Silva & Tavares-Dias, 2018). As parasites are components of most ecosystems, occurring in all food webs and at all trophic levels, several vertebrate and invertebrate species serve as hosts for one or more species of parasites (Lagrue et al., 2011; Cardoso et al., 2017; Baia et al., 2018). In wild fish populations, parasite communities differ in richness and diversity according to their behavior, diet of hosts and the parasite life cycle. The different species of fish living in sympatry may present a similar pattern of parasites when compared to species living in allopatry (Cardoso et al., 2017). Thus, this study compared the parasite fauna in *A. leucostictus*, *H. ventromaculatus*, *Ancistrus* sp. and *Hemiancistrus* sp. from the Igarapé Fortaleza River, and presented a checklist of the parasite species in Loricariidae from Brazil.

Material and methods

Study area, fish and locality of collection

The Igarapé Fortaleza basin, located in the municipalities of Macapá and Santana (AP), is formed by a main channel and an extensive area of floodplains that suffer periodic flooding and is strongly influenced by the high rainfall of the Amazon region and the daily tides of the Amazon River, thus providing shelter and feeding for different species of fish. The regional vegetation is composed of plants with characteristics of flooded forests and herbaceous fields, and several species of macrophytes (Thomaz, Costa-Neto, & Tostes, 2004; Tavares-Dias, Oliveira, Gonçalves, & Silva, 2014).

From November 2013 to August 2014, fifty three specimens of *A. leucostictus*, sp., *H. ventromaculatus*, *Ancistrus* sp. and *Hemiancistrus* sp. were collected in Igarapé Fortaleza River, municipality of Macapá, State of Amapá, Brazil (Figure 1). All fish were collected with gill nets of different mesh sizes, for parasitological analysis.

Collection procedures and analyses of parasites

All fish were weighed (g) and measured for total length (cm), and then necropsied for parasitological analysis. The mouth, opercula, gills and gastrointestinal tract were examined to collect the parasites (protozoans and metazoans). Gills were removed, fixed in formalin 5% and analyzed with the aid of a microscope. To quantify metazoan parasites, each viscera was dissected separately and washed with sodium chloride solution (0.85%) and examined under a stereomicroscope. Previously described techniques were used to collect, count, fix, preserve, and stain the parasites for identification (Eiras, Takemoto, & Pavanelli, 2006; Boeger & Viana, 2006). To analyze the parasites, the ecological terms used were those recommended by Bush, Lafferty, Lotz & Shostak (1997).

A review on the parasites of Loricariidae species in Brazil was performed by searching databases (SciELO, ISI, Scopus, Science Direct, Zoological Records, CAB Abstracts databases and Google Scholar), and available data regarding the parasitic fauna were added to Table 1.

Results

Species of Protozoa, Monogenea, Nematoda, Digenea, Acantocephala, Cestoda, Crustacea and Hirudinea were found parasitizing species of Loricariidae from Brazil, but the most frequent taxonomic groups are Monogenea, Digenea and Nematoda (Table 1). However, the greatest species richness is for Monogenea (Figure 2).

The weight, total length and number of examined hosts are listed in Table 2.

A total of 1,559 parasites were collected from 53 fish specimens, which infected gills and gut of hosts. *Unilatus unilatus* Mizelle et Kritsky, 1967 and *Trinigyryus mourei* Boeger and Bemont-Jégu, 1994 were the most frequent parasites, infecting four host species, followed by *Genarchella gernachella* Travassos 1928 and larvae of *Raphidascaris* (*Sprentascaris*) Peter and Cassone, 1984. Larvae of *Proteocephalus* Weinland, 1858 occurred only in one host species. *Hypostomus ventromaculatus* harbored the highest diversity of parasites, followed by *Ancistrus* sp. (Table 3).

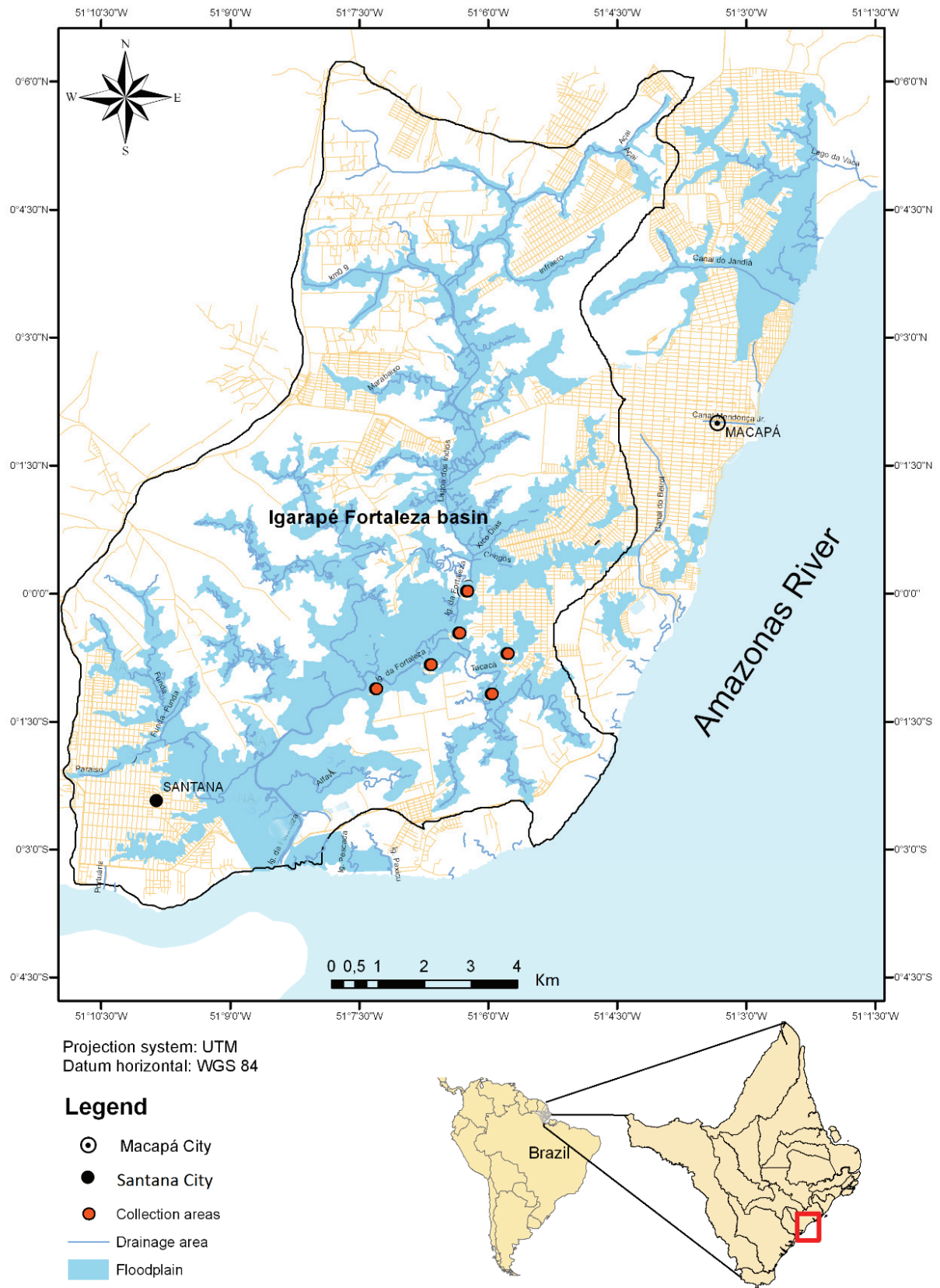


Figure 1. Collection site of the Loricariidae species in Igarapé Fortaleza basin in the Amapá State (Brazil).

Table 1. Checklist of parasite species in Loricariidae fish from the Brazil.

Species of parasites	Species of hosts	Locality	References
<i>Spiroucleus</i> sp.	<i>Harttia duriventris</i>	Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
<i>Ichthyophthirius multifiliis</i>		Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
	<i>Squaliforma emarginatus</i>	Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
	<i>Hypostomus iheringii</i>	Chavantes Reservoir (SP)	Zica et al. (2012)
	<i>Hypostomus regani</i>	Chavantes Reservoir (SP)	Zica et al. (2012)
<i>Unilatus unilatus</i>	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
	<i>Hypostomus strigaticeps</i>	Chavantes Reservoir (SP)	Zica et al. (2012)
	<i>Pterygoplichthys pardalis</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Unilatus irae</i>	<i>Leporacanthicus galaxias</i>	Guamá River (PA)	Branches & Domingues (2014)
<i>Unilatus</i> sp.	<i>Pterygoplichthys pardalis</i>	Manaus (AM)	Porto et al. (2012)
<i>Phanerothecium harrisi</i>	<i>Hypostomus</i> sp.	Tocantins River (TO)	Kritsky, Vianna, & Boeger (2007)
	<i>Hypostomus plecostomus</i>	Manaus (AM)	Kritsky & Boeger (1991)
<i>Phanerothecium spinatoides</i>	<i>Hypostomus</i> sp.	Tocantins River (TO)	Kritsky et al. (2007)
<i>Phanerothecium deiropedeum</i>		Capivari Dam (PR)	Kritsky et al. (2007)
<i>Phanerothecium spinatus</i>	<i>Hypostomus punctatus</i>	Guandu River (RJ)	Boeger, Kritsky, & Belmont-Jégu (1994)
<i>Phanerothecium spinulatum</i>	<i>Hypostomus regani</i>	Rio das Almas (SP)	Kritsky et al. (2007)
	<i>Hypostomus</i> sp.	Tocantins River (TO)	Kritsky et al. (2007)
<i>Phanerothecioides agostinhoi</i>	<i>Hypostomus affinis</i>	Guandu River (RJ)	Azevedo, Abdallah, & Luque (2010); Azevedo, Abdallah, & Luque (2011)
<i>Nothogyrrodactylus clavatus</i>		Manaus (AM)	Kritsky & Boeger (1991)
<i>Nothogyrrodactylus amazonicus</i>	<i>Ancistrus</i> sp.	Manaus (AM)	Kritsky & Boeger (1991)
<i>Nothogyrrodactylus plaesiophallus</i>		Manaus (AM)	Kritsky & Boeger (1991)
<i>Nothogyrrodactylus</i> sp.	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Onychogyrrodactylus hydaticus</i>	<i>Ancistrus multispinis</i>	Salto Morato River (PR)	Kritsky et al. (2007)
<i>Onychogyrrodactylus sudis</i>		Salto Morato River (PR)	Kritsky et al. (2007)
<i>Oogyrrodactylus farlowellae</i>	<i>Farlowella amazonum</i>	Manaus (AM)	Kritsky & Boeger (1991)
<i>Trinigyus mourei</i>	<i>Squaliforma emarginatus</i>	Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
<i>Trinigyus hypostomatis</i>	<i>Hypostomus affinis</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Hyperpletes malmbergi</i>		Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Aglaogyrrodactylus salebrosus</i>		Patos River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus conei</i>	<i>Pareiorhaphis parmula</i>	Patos River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus ctenistus</i>		Patos River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus forficulatus</i>	<i>Kronichthys lacerta</i>	Salto Morato River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus pedunculatus</i>	<i>Hisonotus</i> sp.	Dois de Ferveiro River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus calamus</i>	<i>Schizolecis guntheri</i>	Várzea River (PR)	Kritsky et al. (2007)
<i>Aglaogyrrodactylus forficuloides</i>		Cabral River (PR)	Kritsky et al. (2007)
<i>Paranaella luquei</i>	<i>Hypostomus</i> sp.	Paraná River (PR)	Kohn, Baptista-Farias, & Cohen (2000)
	<i>Rhinelepis aspera</i>	Paraná River (PR)	Kohn et al. (2000)
<i>Hyperpletes malmbergi</i>	<i>Rhineloricaria</i> sp.	Puraquequara River (AM)	Boeger et al. (1994)
<i>Demidospermus paranaensis</i>	<i>Loricariichthys platymetopon</i>	Paraná River (PR)	Ferrari-Hoeninghaus, Bellay, Takemoto, & Pavanelli (2010)
<i>Demidospermus spirophallus</i>	<i>Loricaria proluxa</i>	Batalha River	Pelegrini, Januário, Azevedo & Abdallah et al. (2018); Franceschini et al. (2018)
<i>Demidospermus anus</i>	<i>Loricariichthys platymetopon</i>	Paraná River	Franceschini et al. (2018)
<i>Demidospermus proluxus</i>	<i>Loricaria proluxa</i>	Sapucaí-Mirim River	Franceschini et al. (2018)
<i>Demidospermus rhinelepis</i>	<i>Rhinelepis aspera</i>	Paraná River (PR)	Acosta, Scholz, Blasco-Costa & Silva (2018)
<i>Demidospermus</i> sp.	<i>Loricariichthys castaneus</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Heteropriapulus</i> sp.	<i>Pterygoplichthys pardalis</i>	Manaus (AM)	Porto et al. (2012)
<i>Paracapillaria piscicola</i>	<i>Hypostomus affinis</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
	<i>Hypostomus albopunctatus</i>	Paraná River (PR)	Moravec, Kohn, & Fernandes (1990)
	<i>Hypostomus commersoni</i>	Paraná River (PR)	Moravec et al. (1990)
	<i>Hypostomus derbyi</i>	Paraná River (PR)	Moravec et al. (1990)
	<i>Ancistrus cirrhosus</i>	Paraná River (PR)	Moravec et al. (1990)
<i>Raphidascaris (Sprentascaris) hypostomi</i>	<i>Hypostomus</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Loricaria</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Loricariichthys platymetopon</i>	Paraná River (PR)	Takemoto et al. (2009); Kohn et al. (2011)
	<i>Loricariichthys rostratus</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Pseudohemiodon laticeps</i>	Paraná River (PR)	Moravec et al. (1990); Kohn et al. (2011)
	<i>Loricariichthys</i> sp.	Paraná River (PR)	Kohn et al. (2011)

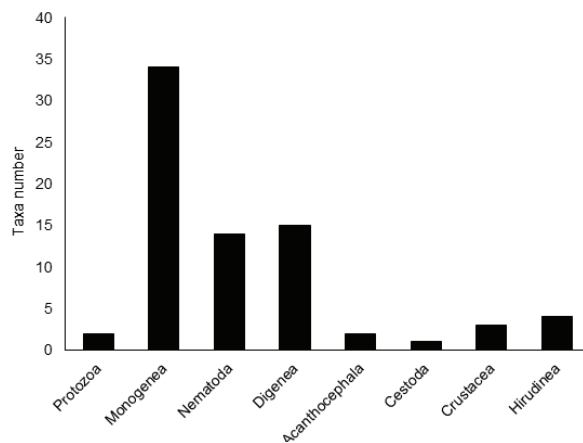
Species of parasites	Species of hosts	Locality	References
<i>Rhabdochona kidderi</i>	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Rhabdochona</i> sp.	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Oxyuricassis coronatus</i>	<i>Lasiancistrus saetiger</i>	Guamá River (PA)	Rodrigues, Santos, Furtado, & Melo (2017)
<i>Oxyuricassis hexaspinatus</i>	<i>Lasiancistrus saetiger</i>	Guamá River (PA)	Rodrigues et al. (2017)
<i>Cucullanus (Cucullanus) pinnae</i>	<i>Loricaria</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Ichthyouris brasiliensis</i>	<i>Megalancistrus parananus</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Hypostomus regani</i>	Paraná River (PR)	Kohn et al. (2011)
<i>Procamallanus (Procamallanus) annipetterae</i>	<i>Hypostomus</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Megalancistrus parananus</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Squaliforma emarginatus</i>	Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
<i>Procamallanus (Spirocamallanus) inopinatus</i>	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Procamallanus (Spirocamallanus) rebeae</i>	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Parasynodontistia petterae</i>	<i>Rhinelepis strigosa</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Loricariichthys castaneus</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Contracaecum</i> sp.	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Hysterothylacium</i> sp.	<i>Loricariichthys</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Hypostomus affinis</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
	<i>Hypostomus iheringii</i>	Chavantes Reservoir (SP)	Zica et al. (2011)
	<i>Hypostomus hermanni</i>	Chavantes Reservoir (SP)	Zica et al. (2011)
	<i>Hypostomus margaritifer</i>	Chavantes Reservoir (SP)	Zica et al. (2011)
		Paraná River (PR)	Yamada, Moreira, Ceschini, Takemoto, & Pavanelli (2008)
		Parapanema River (SP)	Zica et al. (2009)
	<i>Hypostomus regani</i>	Paraná River (PR)	Takemoto et al. (2009)
		Chavantes Reservoir (SP)	Zica et al. (2011)
		Chavantes Reservoir (SP)	Zica et al. (2011)
		Chavantes Reservoir (SP)	Zica et al. (2011)
	<i>Hypostomus</i> sp.	Chavantes Reservoir (SP)	Zica et al. (2011)
	<i>Hypostomus strigaticeps</i>	Chavantes Reservoir (SP)	Zica et al. (2011)
<i>Austrodiplostomum compactum</i>	<i>Potamohina pristigaster</i>	Solimões River (AM)	Vital, Morey, Pereira, & Malta (2016)
	<i>Loricariichthys castaneus</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
	<i>Potamohina latior</i>	Solimões River (AM)	Vital et al. (2016)
	<i>Pterygoplichthys pardalis</i>	Manaus (AM)	Porto et al. (2012)
	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Austrodiplostomum</i> sp.	<i>Loricariichthys castaneus</i>	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
<i>Crassicutis intermedius</i>	<i>Hypostomus regani</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Hypostomus</i> sp.	Paraná River (PR)	Kohn et al. (2011)
<i>Crassicutis cichlasomae</i>	<i>Loricaria</i> sp.	Paraná River (PR)	Kohn et al. (2011)
<i>Clinostomum marginatum</i>		Paraná River (PR)	Eiras, Dias, Pavanelli, & Machado (1999); Takemoto et al. (2009)
<i>Clinostomum complanatum</i>		Paraná River (PR)	Ferrari-Hoeninghaus, Takemoto, & Pavanelli (2007); Dias et al. (2006)
	<i>Loricariichthys platymetopon</i>	Paraná River (PR)	Ferrari-Hoeninghaus et al. (2007); Takemoto et al. (2009)
<i>Crocodylicola pseudostoma</i>	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Clinostomum detruncatum</i>	<i>Megalancistrus parananus</i>	Paraná River (PR)	Kohn et al. (2011)
<i>Dadaytremia</i> sp.		Paraná River (PR)	Kohn et al. (2011)
<i>Genarchella tropica</i>		Paraná River (PR)	Kohn et al. (2011)
<i>Genarchella genarchella</i>	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Saccocoeloides magnus</i>	<i>Megalancistrus parananus</i>	Paraná River (PR)	Kohn et al. (2011)
	<i>Pterygoplichthys pardalis</i>	Janauacá Lake (AM)	Thatcher & Varella (1981)
<i>Megacoelium spinicavum</i>	<i>Pterygoplichthys</i> sp.	Lago Janauacá River (AM)	Thatcher & Varella (1981)
	<i>Pterygoplichthys pardalis</i>	Manaus (AM)	Porto et al. (2012)
<i>Acanthostomum gnerii</i>		Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Dendrorchis</i> sp.	<i>Pterygoplichthys</i> sp.	Paraná River (PR)	Kohn et al. (2011)
<i>Gorytocephalus</i> sp.	<i>Hypostomus</i> sp.	Paraná River (PR)	Kohn et al. (2011)
	<i>Pterygoplichthys pardalis</i>	Manaus (AM)	Porto et al. (2012)
		Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Gorytocephalus elongorchis</i>	<i>Hypostomus carinatus</i>	Janauacá Lake (AM)	Thatcher (1979)
	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Proteocephalus</i> sp.		Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Riggia acuticaudata</i>	<i>Ancistrus</i> sp.	Manaus (AM)	Oda et al. (2015)
<i>Dolops longicauda</i>	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Ergasilus</i> sp.	<i>Hypostomus affinis</i>	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
	<i>Loricariichthys castaneus</i>	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
<i>Placobdella</i> sp.	<i>Hypostomus affinis</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Helobdella</i> sp.	<i>Loricariichthys castaneus</i>	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
<i>Oligobdella</i> sp.	<i>Loricaria prolixa</i>	Batalha River	Pelegrini et al. (2018)
<i>Hirudinea</i> gen. sp.	<i>Peckoltia braueri</i>	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
<i>Hirudinea Glossiphoniidae</i>	<i>Hypostomus affinis</i>	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
	<i>Loricariichthys castaneus</i>	Lages Reservoir (RJ)	Paraguassú & Luque (2007)

AM: Amazonas, AP: Amapá, PR: Paraná, PA: Pará, TO: Tocantins, SP: São Paulo, RJ: Rio de Janeiro.

Table 3. Parasitic indices four Loricariidae species from the Igarapé Fortaleza River, Amapá State, Brazil.

Species of parasites	<i>Unilatus unilatus</i> and <i>Trinigyryus mourei</i>	<i>Unilatus unilatus</i>	Undetermined metacercariae	<i>Genarchella gernachella</i>	<i>Raphidascaris (Sprentascaris sp.)</i>	<i>Gorythocephalus elongorchis</i>	<i>Proteocephalus sp.</i>
<i>Ancistrus leucostictus</i>	P (%)	75.0	0	0	25.0	25.0	0
	MI	43.0	0	0	34.0	24.0	0
	MA $\pm$ SD	32.3 $\pm$ 37.4	0	0	8.5 $\pm$ 17.0	6.0 $\pm$ 12.0	0
	Range	13.0-85.0	0	0	-	-	0
	TNP	129	0	0	34	24	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine
<i>Ancistrus sp.</i>	P (%)	64.3	0	0	15.0	5.0	0
	MI	141.4	0	0	7.3	1	0
	MA $\pm$ SD	90.9 $\pm$ 201.4	0	0	1.1 $\pm$ 3.9	0.1 $\pm$ 0.2	0
	Range	1.0-748.0	0	0	1.0 - 17.0	-	0
	TNP	1273	0	0	22	1	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine
<i>Hypostomus ventromaculatus</i>	P (%)	0	100	100	28.6	0	9.5
	MI	0	0.2	0.2	3.5	0	9.0
	MA $\pm$ SD	0	2.0 $\pm$ 0.0	2.0	1.0 $\pm$ 2.9	0	0.9 $\pm$ 3.7
	Range	0	-	-	1.0 - 13.0	0	1.0 - 17.0
	TNP	0	4	2	21	0	18
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine
<i>Hemiancistrus sp.</i>	P (%)	28.6	0	0	0	25.0	0
	MI	119.5	0	0	0	3.5	0
	MA $\pm$ SD	34.1 $\pm$ 89.9	0	0	0	9.0 $\pm$ 2.1	0
	Range	1.0-238.0	0	0	0	1.0-6.0	0
	TNP	239	0	0	0	7	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine

P: Prevalence, MI: Mean intensity, MA: Mean abundance SD: Standard deviation, TNP: Total number of parasites, SI: Site of infection.

**Figure 2.** Richness of the parasite taxa in Loricariidae species from the Brazil.**Table 2.** Body parameters of Loricariidae species from the Igarapé Fortaleza River, Amapá State (Brazil).

Species of hosts	N	Weight (g)	Length (cm)
<i>Ancistrus leucostictus</i>	4	15.1 $\pm$ 1.9	47.0 $\pm$ 17.8
<i>Ancistrus sp.</i>	20	15.0 $\pm$ 3.7	62.4 $\pm$ 53.0
<i>Hemiancistrus sp.</i>	8	12.4 $\pm$ 3.2	33.0 $\pm$ 37.1
<i>Hypostomus ventromaculatus</i>	21	17.2 $\pm$ 2.4	58.7 $\pm$ 19.1

Discussion

Some patterns of composition and structure of the parasite community in Loricariidae from Brazil were detected: (a) presence of ectoparasites (Protozoa, Monogenea, Crustacea and Hirudinea) and endoparasites (Nematoda, Digenea, Acanthocephala and Cestoda); (b) dominance of *Austrodiplostomum compactum* Lutz, 1928; (c)

infracommunities of ectoparasites richer and more diverse than endoparasites; (d) the presence of endoparasites at the larval stage with high prevalence and low abundance; (e) overdispersion of parasites and (f) interspecific associations of parasite infracommunities (Table 1). There are few studies on parasites in Loricariidae species in the Igarapé Fortaleza basin (Gonçalves et al., 2014; Cardoso et al., 2017). However, this was the first study for *A. leucostictus*, *H. ventromaculatus*, *Ancistrus sp.* and *Hemiancistrus sp.*

In wild fish populations, the parasitic fauna depend on internal and external factors such as: seasonal variations, habitat, limnological characteristics, water body depth, local biota, biological and physiological characteristics of the hosts, trophic level of thost population and geography of region (Dogiel, 1961; Lagrue et al., 2011; Cardoso et al., 2017; Baia et al., 2018). The parasites, including monogeneans, can then be positively or negatively influenced by environmental stressors, mainly by anthropic actions that favor the eutrophication of water bodies, altering the parasites abundance in polluted environments (Takemoto et al., 2009).

Monogenea has life cycle in a single host and, in general, of a same family of fish, such as Loricariidae, which are commonly parasitized by species of *Demidospermus*, *Paranaella*, *Trinigyryus* and *Unilatus* (Boeger & Vianna, 2006; Braga, Araújo, & Boeger, 2014). In general, monogeneans are found in low prevalence and abundance in wild fish

populations, when the environmental characteristics do not facilitate the reproduction of these ectoparasites (Tavares-Dias, Rigôr, Pinheiro, Oliveira, & Marinho, 2013). *Unilatus unilatus* and *T. mourei* have been reported infecting diverse Loricariidae species from Brazil (Table 1), and now also *A. leucostictus*, *Ancistrus* sp., *H. ventromaculatus* and *Hemiancistrus* sp., which are new hosts for such monogeneans.

Digeneans are parasites of different host species and have mollusks as primary intermediate hosts, and fish can be intermediate, paratenic or definitive hosts (Ferrari-Hoeninghaus et al., 2007; Cardoso et al., 2017). *Genarchella gernachella* does not have host specificity, since it infects several Characiformes and Siluriformes fish from Brazil, which can be definitive hosts for this digenean specie (Cardoso et al., 2017). Undetermined metacercariae and *G. gernachella* were found in *A. leucostictus*, *Ancistrus* sp. and *H. ventromaculatus*, but the greatest prevalence occurred in intestine of *H. ventromaculatus*. This was the first report of *G. genarchella* for *Ancistrus* sp., *A. leucostictus* and *H. ventromaculatus*.

Species of *Raphidascaris* (*Sprentascaris*) are nematodes with little known life cycle, but require fish and aquatic crustaceans as intermediate hosts; in addition amphibians, aquatic insects, zooplankton, etc. which are less likely to be intermediate or paratenic hosts (Moravec, 1998). For *A. leucostictus*, *Ancistrus* sp. and *Hemiancistrus* sp., there were varied infection levels of *Raphidascaris* (*Sprentascaris*) sp. *Raphidascaris* (*S.*) *hipostomi* Peter and Cassone, 1984 and *Raphidascaris* (*S.*) *mahnerti* Peter and Cassone, 1984 (Table 1) are known infecting Loricariidae species, but this was the first record of *Raphidascaris* (*Sprentascaris*) sp. for *A. leucostictus*, *Ancistrus* sp. and *Hemiancistrus* sp.

Acanthocephalans are endoparasites of fish, birds and mammal (Cardoso et al., 2017). *Gorytocephalus elongorchis* Thatcher (1979), a parasite of Loricariidae species (Table 1), was found only in *H. ventromaculatus*, which are new hosts for this acanthocephalan. Species of *Proteocephalus* are common cestodes of Siluriformes, which consume planktonic crustaceans (Copepoda and Cyclopoida) that serve as intermediate hosts. Thus, some species of Siluriformes can be definitive hosts, with direct infection after consuming microcrustaceans (Scholz, 1999; Cardoso et al., 2017). Plerocercoids of *Proteocephalus* sp. were found only in *H. ventromaculatus*, which can be secondary intermediate host for this endoparasite. In addition, *H. ventromaculatus* is a new host for *Proteocephalus* sp.

Conclusion

Ectoparasites were predominant in the examined Loricariidae species, which also had species of endoparasites at the larval stage. The hosts with the highest number of collected samples (*H. ventromaculatus* and *Ancistrus* sp.) had a higher richness of parasite species. The species of Loricariidae from Brazil present ecto- and endoparasites, but the predominance is of ectoparasites. Species of monogeneans, digeneans and nematodes are the most diversified parasites in Brazilian Loricariidae.

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