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ZOOLOGY

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*, *Trinigyrus 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*, *Trinigyrus 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 detritivorus 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 *Trinigyrus 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).

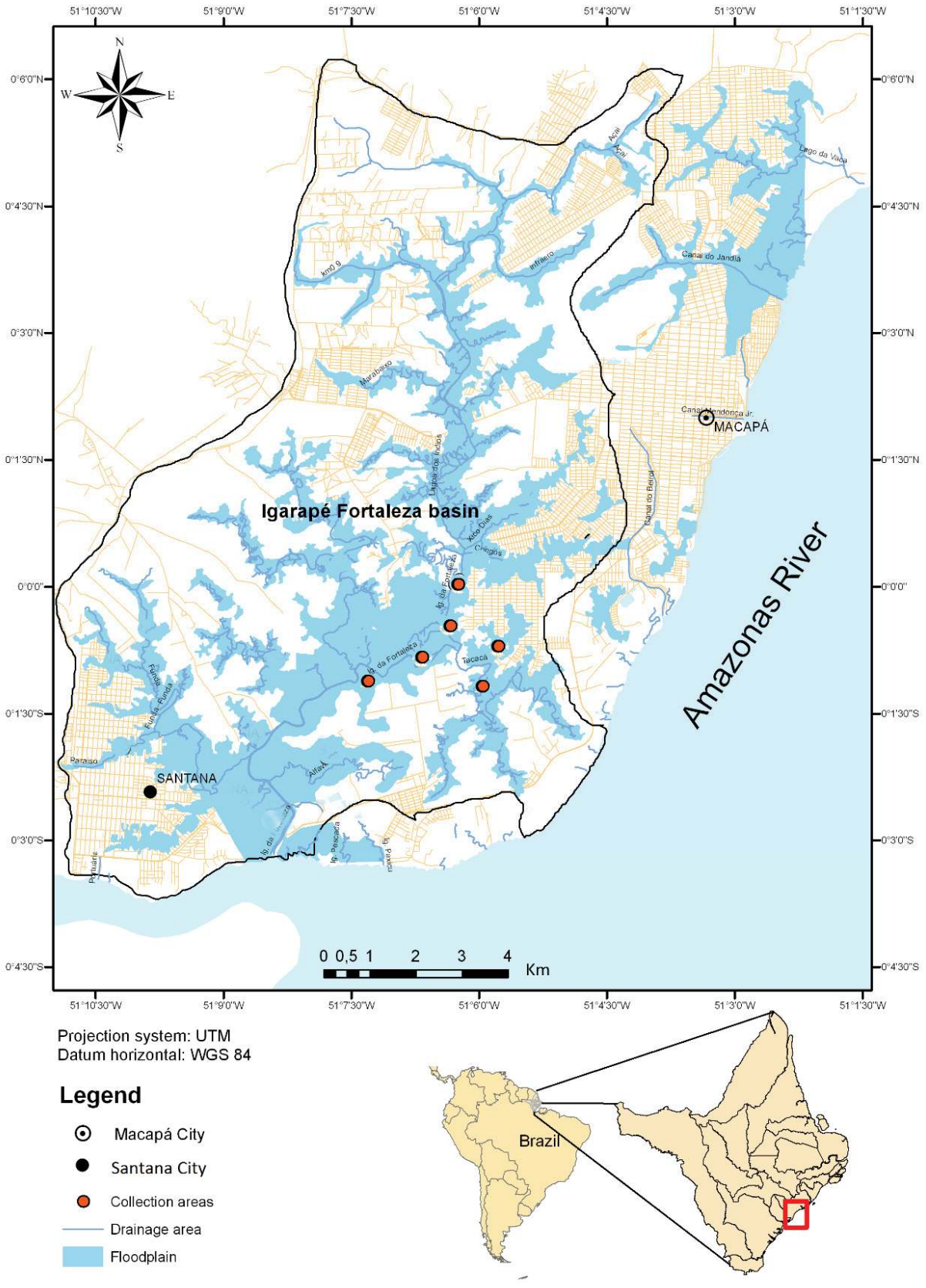

Figure 1. Collection site of the Loricariidae species in Igarapé Fortaleza basin in the Amapá Satate (Brazil).

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

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

Species of parasites	*Species of hosts*	Locality	References
Rhabdochona kidderi	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Rhabdochona sp.	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Oxyuricassis coronatus	*Lasiancistrus saetiger*	Guamá River (PA)	Rodrigues, Santos, Furtado, & Melo (2017)
Oxyuricassi hexaspinatus	*Lasiancistrus saetiger*	Guamá River (PA)	Rodrigues et al. (2017)
Cucullanus (*Cucullanus*) *pinnai*	*Loricaria* sp.	Paraná River (PR)	Kohn et al. (2011)
	Loricaria prolixa	Batalha River	Pelegrini et al. (2018)
Ichthyouris brasiliensis	*Megalancistrus parananus*	Paraná River (PR)	Kohn et al. (2011)
	Hypostomus regani	Paraná River (PR)	Kohn et al. (2011)
Procamallanus (*Procamallanus*)	*Hypostomus* sp.	Paraná River (PR)	Kohn et al. (2011)
annipetterae	*Megalancistrus parananus*	Paraná River (PR)	Kohn et al. (2011)
	Squaliforma emarginatas	Igarapé Fortaleza River (AP)	Gonçalves et al. (2014)
Procamallanus (*Spirocamallanus*) *inopinatus*	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Procamallanus (*Spirocamallanus*) *rebecae*	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Parasynodontisia petterae	*Rhinelepis strigosa*	Paraná River (PR)	Kohn et al. (2011)
	Loricariichthys castaneus	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
Contracaecum sp.	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Hysterothylacium sp.	*Loricariichthys* sp.	Paraná River (PR)	Kohn et al. (2011)
	Hypostomus affinis	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
	Hypostomus iheringii	Chavantes Reservoir (SP)	Zica et al. (2011)
	Hypostomus hermanni	Chavantes Reservoir (SP)	Zica et al. (2011)
	Hypostomus margaritifer	Chavantes Reservoir (SP)	Zica et al. (2011)
		Paraná River (PR)	Yamada, Moreira, Ceschini, Takemoto, & Pavanelli (2008)
		Parapanema River (SP)	Zica et al. (2009)
	Hypostomus regani	Paraná River (PR)	Takemoto et al. (2009)
		Chavantes Reservoir (SP)	Zica et al. (2011)
		Chavantes Reservoir (SP)	Zica et al. (2011)
	Hypostomus sp.	Chavantes Reservoir (SP)	Zica et al. (2011)
	Hypostomus strigaticeps	Chavantes Reservoir (SP)	Zica et al. (2011)
Austrodiplostomum compactum	*Potamohina pristigaster*	Solimões River (AM)	Vital, Morey, Pereira, & Malta (2016)
	Loricariichthys castaneus	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
	Potamohina latior	Solimões River (AM)	Vital et al. (2016)
	Pterygoplichthys pardalis	Manaus (AM)	Porto et al. (2012)
	Loricaria prolixa	Batalha River	Pelegrini et al. (2018)
Austrodiplostomum sp.	*Loricariichthys castaneus*	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
Crassicutis intermedius	*Hypostomus regani*	Paraná River (PR)	Kohn et al. (2011)
	Hypostomus sp.	Paraná River (PR)	Kohn et al. (2011)
Crassicutis cichlasomae	*Loricaria* sp.	Paraná River (PR)	Kohn et al. (2011)
Clinostomum marginatum		Paraná River (PR)	Eiras, Dias, Pavanelli, & Machado (1999); Takemoto et al. (2009)
Clinostomum complanatum		Paraná River (PR)	Ferrari-Hoeinghaus, Takemoto, & Pavanelli (2007); Dias et al. (2006)
Crocodilicola pseudostoma	*Loricariichthys platymetopon*	Paraná River (PR)	Ferrari-Hoeinghaus et al. (2007); Takemoto et al. (2009)
Clinostomum detruncatum	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Dadaytrema sp.	*Megalancistrus parananus*	Paraná River (PR)	Kohn et al. (2011)
Genarchella tropica		Paraná River (PR)	Kohn et al. (2011)
Genarchella genarchella	*Peckoltia braueri*	Igarapé Fortaleza River(AP)	Cardoso et al. (2017)
Saccocoelioides magnus	*Megalancistrus parananus*	Paraná River (PR)	Kohn et al. (2011)
	Pterygoplichthys pardalis	Janauacá Lake (AM)	Thatcher & Varella (1981)
Megacoelium spinicavum	*Pterygoplichthys* sp.	Lago Janauacá River (AM)	Thacther & Varella (1981)
	Pterygoplichthys pardalis	Manaus (AM)	Porto et al. (2012)
Acanthostomum gnerii		Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
Dendrorchis sp.	*Pterygoplichthys* sp.	Paraná River (PR)	Kohn et al. (2011)
Gorytocephalus sp.	*Hypostomus* sp.	Paraná River (PR)	Kohn et al. (2011)
	Pterygoplichthys pardalis	Manaus (AM)	Porto et al. (2012)
		Igarapé Fortaleza River	Cardoso et al. (2017)
Gorytocephalus elongorchis		(AP)	
	Hipostomus carinatus	Janauacá Lake (AM)	Thatcher (1979)
	Peckoltia braueri	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
Proteocephalus sp.		Igarapé Fortaleza River(AP)	Cardoso et al. (2017)
Riggia acuticaudata	*Ancistrus* sp.	Manaus (AM)	Oda et al. (2015)
Dolops longicauda	*Peckoltia braueri*	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
Ergasilus sp.	*Hypostomus affinis*	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
	Loricariichthys castaneus	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
Placobdella sp.	*Hypostomus affinis*	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
Helobdella sp.	*Loricariichthys castaneus*	Guandu River (RJ)	Azevedo et al. (2010); Azevedo et al. (2011)
Oligobdella sp.	*Loricaria prolixa*	Batalha River	Pelegrini et al. (2018)
Hirudinea gen. sp.	*Peckoltia braueri*	Igarapé Fortaleza River (AP)	Cardoso et al. (2017)
Hirudinea Glossiphoniidae	*Hypostomus affinis*	Lages Reservoir (RJ)	Paraguassú & Luque (2007)
	Loricariichthys castaneus	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		*Unilatus unilatus* and *Trinigyrus mourei*	*Unilatus unilatus*	Undetermined metacercariae	*Genarchella gernachella*	*Raphidascaris* (*Sprentascaris* sp.)	*Gorythocephalus elongorchis*	*Proteocephalus* sp.
Ancistrus leucostictus	P (%)	75.0	0	0	25.0	25.0	0	0
	MI	43.0	0	0	34.0	24.0	0	0
	MA ± SD	32.3 ± 37.4	0	0	8.5 ± 17.0	6.0 ± 12.0	0	0
	Range	13.0-85.0	0	0	-	-	0	0
	TNP	129	0	0	34	24	0	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine	Intestine
Ancistrus sp.	P (%)	64.3	0	0	15.0	5.0	0	0
	MI	141.4	0	0	7.3	1	0	0
	MA ± SD	90.9 ± 201.4	0	0	1.1 ± 3.9	0.1 ± 0.2	0	0
	Range	1.0-748.0	0	0	1.0 - 17.0	-	0	0
	TNP	1273	0	0	22	1	0	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine	Intestine
Hypostomus ventromaculatus	P (%)	0	100	100	28.6	0	9.5	4.8
	MI	0	0.2	0.2	3.5	0	9.0	17.0
	MA ± SD	0	2.0 ± 0.0	2.0	1.0 ± 2.9	0	0.9 ± 3.7	0.8 ± 3.7
	Range	0	-	-	1.0 - 13.0	0	1.0 - 17.0	-
	TNP	0	4	2	21	0	18	17
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine	Intestine
Hemiancistrus sp.	P (%)	28.6	0	0	0	25.0	0	0
	MI	119.5	0	0	0	3.5	0	0
	MA ± SD	34.1 ± 89.9	0	0	0	9.0 ± 2.1	0	0
	Range	1.0-238.0	0	0	0	1.0-6.0	0	0
	TNP	239	0	0	0	7	0	0
	SI	Gills	Gills	Gills	Intestine	Intestine	Intestine	Intestine

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

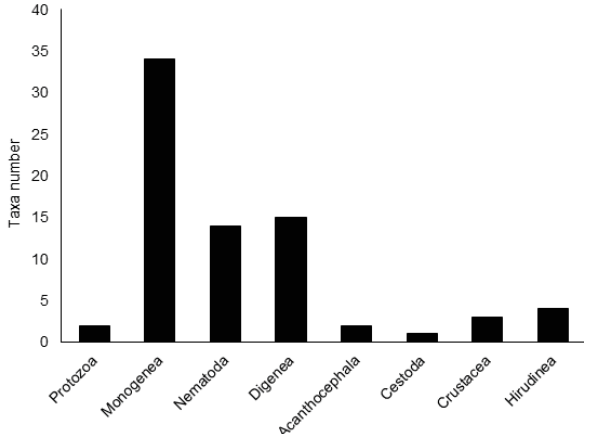

Figure 2. Richness of the parasite taxa in Loricaridae species from the Brazil.

Table 2. Body parameters of Loricariidae species from the Igarapé Fortaleza River, Amapá State (Brazil).

Species of hosts	N	Weight (g)	Length (cm)
Ancistrus leucostictus	4	15.1 ± 1.9	47.0 ± 17.8
Ancistrus sp.	20	15.0 ± 3.7	62.4 ± 53.0
Hemiancistrus sp.	8	12.4 ± 3.2	33.0 ± 37.1
Hypostomus ventromaculatus	21	17.2 ± 2.4	58.7 ± 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, Acantocephala 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 (Gonçalveset 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*, *Trinigyrus* and *Unilatus* (Boeger & Vianna, 2006; Braga, Aráujo, & 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-Hoeinghaus 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 mammnal (Cardoso et al., 2017). *Gorytocephalus elongorchis* Thatcher (1979), a parasite of Loricariidae species (Table 1), was found only in *H. ventromaculatos*, 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. ventromaculatos* 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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