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Fish from urban tributaries to the Vermelho River, upper Paraguay River Basin, Mato Grosso, Brazil

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Abstract: The fish fauna of urban streams is still poorly known, it difficult to assess the effects of urbanization expansion on fish species composition, for this reason the aim of this study was to provide a checklist of species that compose the ichthyofauna of six urban streams, tributaries to the Vermelho River, upper Paraguay River Basin, Rondonópolis, Mato Grosso State, Brazil. The samples were performed with seine nets on a spatial gradient of 75 m, and with sieves for a period of 15 minutes in each site. A total of 56 species belonging to five orders, Characiformes, Siluriformes, Gymnotiformes, Cyprinodontiformes, and Perciformes, 21 families and 44 genera were sampled. The most common species were *Astyanax asuncionensis* Géry, 1972, *Astyanax abramis* (Jenyns, 1842), *Odontostilbe pequira* (Steindachner, 1882), *Odontostilbe paraguayensis* Eigenmann & Kennedy, 1903, *Characidium zebra* Eigenmann, 1909 and *Hypostomus* sp. This checklist brings additional knowledge on fish that inhabit tributaries to the major rivers of northern Pantanal.

Key words: urban streams, ichthyofauna, Vermelho River Basin

INTRODUCTION

The Brazilian Cerrado has been exposed to a major process of urbanization (Sano *et al.* 2010) and many of the waterways cross urban centers, suffering the impact of human occupation, which is characterized by constant discharge of effluents produced from anthropogenic activities (Paul and Meyer 2001). Among other effects, urbanization leads to habitat degradation, resulting in the reduction of the most sensitive species and in an increased abundance of more resistant species (Cunico *et al.* 2006), as well as greater susceptibility to invasive species (Domingos *et al.* 2013). Unfortunately, the fish fauna from urban streams still is poorly known (Felipe and Suárez 2010), making it difficult to assess the effects of urbanization expansion on fish species composition. Despite the fragility of these streams front of negative influences of anthropic activities (Oliveira and Bermann 2005) in Brazil publications on the ichthyofauna of small streams in Cerrado areas are still rare when compared with what is known about the fish fauna from the main channel of large river basins and their larger tributaries (MMA 2007).

The Vermelho River has several tributaries which flow through the city of Rondonópolis that are subject to the impacts of urbanization (Loverde-Oliveira and Figueiredo 1999) because the drainage area is located in one of the most important regions of the brazilian agribusiness in the central-west of the country where the large-scale agriculture and agricultural products processing industries create a huge possibility of impacts over the fish fauna.

Considering that the knowledge of the fish species from waterways that run through urban environments are important to understand the ecology and conservation of the region, besides indicating the degradation state of the streams under study. For these reasons the aim of this study was to provide the first list of species of fish that inhabit the urban streams of the city of Rondonópolis.

MATERIALS AND METHODS

The study was conducted in six urban streams, tributaries to the Vermelho/São Lourenço Rivers (Upper Paraguay River Basin), in Rondonópolis, Mato Grosso State (Figure 1). These streams are tributaries to the rivers that form the northern Pantanal floodplain.

Fish collections were carried out in August 2010 (dry season) and in May 2011 (rainy season), in urban and rural portions of each stream, totaling 12 sampling stations (n=24 samples). The sampled streams were Arareau, Lourencinho, Lajeadinho, Escondidinho, Macaco and Queixada (Figure 1).

Seine nets were used in the spatial gradient of 75 m and sieves for a period of 15 minutes in each site. The cumulative curve of species (Figure 2) was performed in Vegan package (Oksanen *et al.* 2011) include in R project (R Development Core Team 2011).

Fish caught were kept in 10% formalin, packed in plastic bags and preserved in 70% alcohol. Fish were collected under the license of the Secretaria Estadual de Meio Ambiente do Estado de Mato Grosso (SEMA) (Process numbers 018/2010, 513997/2010). Specimens were identified to the lowest possible taxonomic level based on Britski *et al.* 2007, Benine *et al.* 2009 and Costa 2011. We checked spelling of all scientific

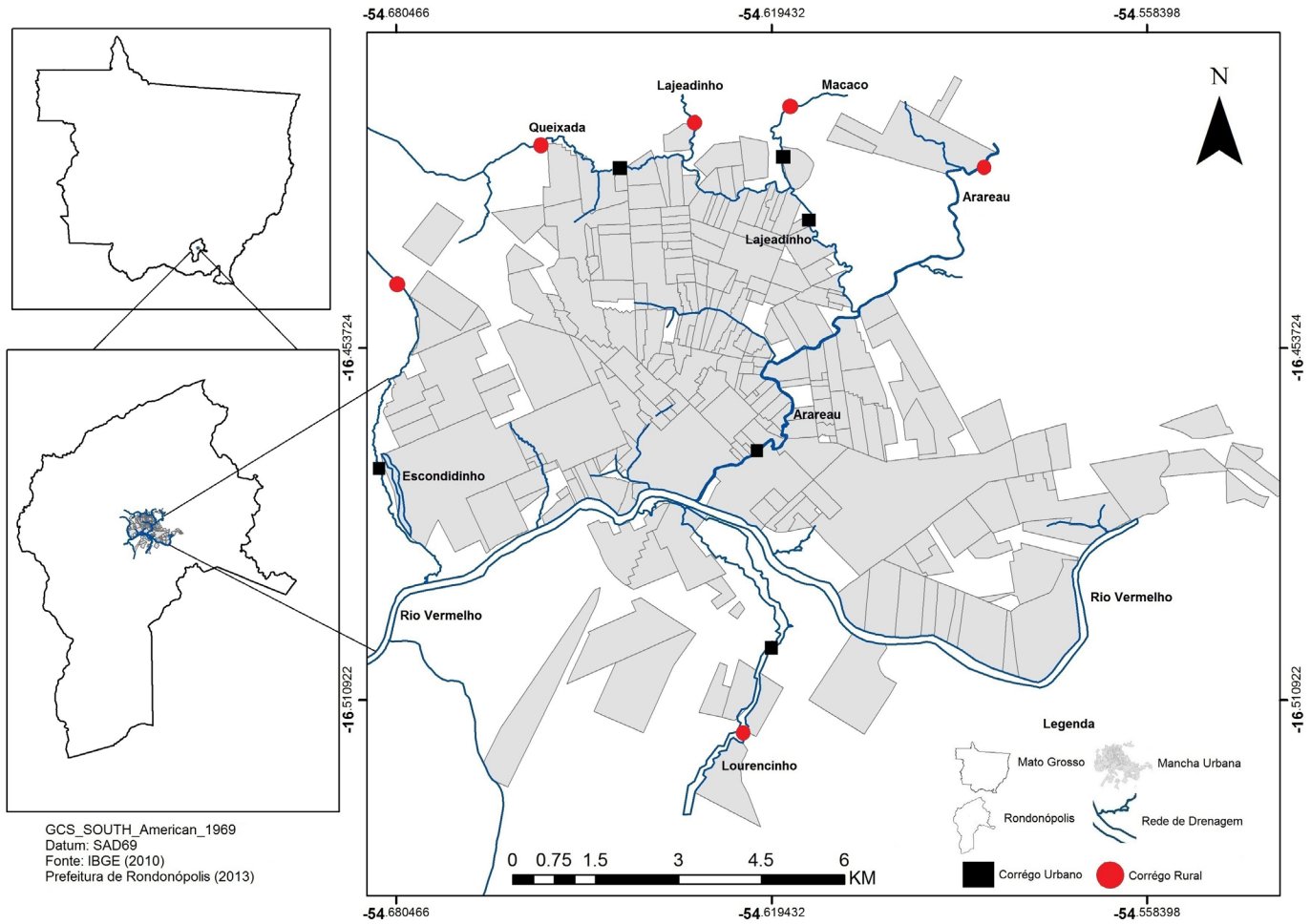

Figure 1. Urban area of Rondonópolis, Mato Grosso, with streams Arareau (16°28′13″S, 54°37′17″W), Lourencinho (16°30′25″S, 54°37′18″W), Lajeadinho (16°26′02″S, 54°36′51″W), Escondidinho (16°28′30″S, 54°40′56″W), Macaco (16°25′19″S, 54°37′05″W) and Queixada (16°25′39″S, 54°38′52″W), tributaries to the Vermelho River.

names against California Academy of Sciences (Eschmeyer 2013). Voucher specimens were deposited in the Ichthyological Collection of the Universidade Federal de Mato Grosso, Brazil.

RESULTS

The fish fauna was composed by 56 species from a sample of 5,038 individuals, belonging to five orders Characiformes, Siluriformes, Gymnotiformes, Cyprinodontiformes and Perciformes, 21 families and 44 genera (Table 1). Species richness in the sampling station showed variation between 17 and 33 taxa/sample. The lowest value of species richness was found in the Lourencinho stream and the greatest richness was recorded in both Lajeadinho and Macaco streams (Table 1). The species richness did not differ between rural and urban sections or periods. The species diversity on average was reduced and similar (<1 bits ind^{-1}) in both periods and sampling locations.

According to the collector curve (Figure 2) the streams were relatively well sampled, because the species richness reached the level of stabilization, however, it does not mean that one or more species could not still be collected.

The orders Characiformes and Siluriformes were predominant in terms of number of species, regardless of the period or sampling site. Characiformes was represented by

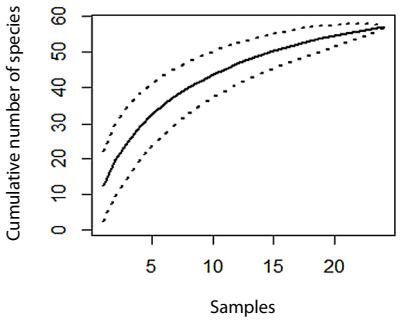

Figure 2. Species accumulation curve (solid line) and confidence interval (dotted line) for the sampled streams in the Vermelho River basin.

29 species from nine families. Among the families recorded, Characidae had the greatest number of taxa (n=22). The order Siluriformes was represented by 16 species of five families. Gymnotiformes was represented by six species of five families. Cyprinodontiformes by one family with one species and Perciformes by one family with four species (Table 1).

The most common species registered herein were *Astyanax asuncionensis* Géry, 1972, *Astyanax abramis* (Jenyns, 1842), *Odontostilbe pequira* (Steindachner, 1882), *Odontostilbe paraguayensis* Eigenmann & Kennedy, 1903, *Characidium zebra* Eigenmann, 1909 and *Hypostomus* sp. (Table 1).

Table 1. Checklist of fish species recorded in each stream, with occurrence of taxa per stream. The streams are represented by A = Arareau, E = Escondidinho, LA = Lajeadinho, Q = Queixada, LO = Lourencinho, M = Macaco.

Taxa	A	E	LA	Q	LO	M	Voucher
CHARACIFORMES							
Parodontidae							
Parodon nasus Kner, 1859	x		x	x		x	CPUFMT1617
Curimatidae							
Steindachnerina brevipinna (Eigenmann & Eigenmann, 1889)	x		x	x		x	CPUFMT1787
Anostomidae							
Leporinus striatus Kner, 1858			x	x			CPUFMT1636
Erythrinidae							
Hoplias malabaricus (Bloch, 1794)		x	x	x	x	x	CPUFMT1741
Erythrinus erythrinus (Bloch & Schneider, 1801)				x			
Lebiasinidae							
Pyrrhulina australis Eigenmann & Kennedy, 1903		x			x		CPUFMT1652
Acestrorhynchidae							
Acestrorhynchinae							
Acestrorhynchus pantaneiro Menezes, 1992					x		CPUFMT1772
Characidae							
Aphyocharacinae							
Aphyocharax dentatus Eigenmann & Kennedy, 1903	x		x			x	CPUFMT1803
Tetragonopterinae							
Jupiaba acanthogaster (Eigenmann, 1911)					x		CPUFMT1613
Creagrutus meridionalis Vari & Harold, 2001	x	x	x			x	CPUFMT1610
Bryconamericus exodon Eigenmann, 1907	x	x	x	x		x	CPUFMT1609
Bryconamericus stramineus Eigenmann, 1908	x	x	x	x		x	CPUFMT1719
Moenkhausia oligolepis (Günther, 1864)			x		x	x	CPUFMT1729
Moenkhausia lopesi Britski & de Silimon, 2001	x		x				CPUFMT1671
Moenkhausia dichroura (Kner, 1858)			x			x	CPUFMT1706
Bryconops clade							
Bryconops melanurus (Bloch, 1794)					x		CPUFMT1760
Stevardiinae							
Piabarchus analis (Eigenmann, 1914)	x		x			x	CPUFMT1698
Pristellinae							
Hemigrammus marginatus Ellis, 1911			x			x	CPUFMT1796
Astyanax clade							
Astyanacinus moorii (Boulenger, 1892)			x			x	CPUFMT1843
Astyanax lineatus (Perugia, 1891)		x	x	x	x	x	CPUFMT1850
Astyanax marionae Eigenmann, 1911			x	x	x	x	CPUFMT1853
Astyanax asuncionensis Géry, 1972	x	x	x	x	x	x	CPUFMT1740
Astyanax abramis (Jenyns, 1842)	x	x	x	x	x	x	CPUFMT1689
Cheirodontinae							
Odontostilbe pequira (Steindachner, 1882)	x	x	x	x	x	x	CPUFMT1672
Odontostilbe paraguayensis Eigenmann & Kennedy, 1903	x	x	x		x	x	CPUFMT1618
Serrapinnus microdon (Eigenmann, 1915)				x		x	CPUFMT1725
Serrapinnus calliurus (Boulenger, 1900)	x		x	x			CPUFMT1699
Characinae							
Cynopotamus kincaidi (Schultz, 1950)						x	CPUFMT1769
Crenuchidae							
Characidiinae							
Characidium zebra Eigenmann, 1909	x	x	x	x	x	x	CPUFMT1766
SILURIFORMES							
Auchenipteridae							
Tatia neivai (Ihering, 1930)		x				x	CPUFMT1844
Heptapteridae							
Pimelodella taenioptera Miranda-Ribeiro, 1914	x						CPUFMT1748
Cetopsidae							
Cetopsinae							
Cetopsis gobioides Kner, 1858						x	CPUFMT1693
Callichthyidae							
Corydoradinae							
Corydoras aeneus (Gill, 1858)	x		x			x	CPUFMT1669

Table 1. Continued.

Taxa	A	E	LA	Q	LO	M	Voucher
Corydoras areio Knaack, 2000				x			CPUFMT1792
Corydoras ellisae Gosline, 1940			x				CPUFMT1709
Loricariidae							
Hypoptopomatinae							
Otocinclus vittatus Regan, 1904	x						CPUFMT1644
Loricariinae							
Brochyloricaria macrodon (Kner, 1853)						x	CPUFMT1603
Farlowella isbruckeri (Retzer & Page, 1997)	x		x			x	CPUFMT1791
Farlowella paraguayensis Retzer & Page, 1997	x		x			x	CPUFMT1711
Loricaria sp.			x				
Pyxiloricaria menezesi Isbrücker & Nijssen, 1984				x			CPUFMT1597
Spatuloricaria evansii (Boulenger, 1892)	x		x			x	CPUFMT1616
Hypostominae							
Hypostomus sp.	x	x	x	x	x	x	CPUFMT1623
Ancistrinae							
Megalancistrus parananus (Peters, 1881)	x	x		x			CPUFMT1666
Ancistrus sp.	x			x			CPUFMT1668
GYMNOTIFORMES							
Sternopygidae							
Eigenmannia trilineata López & Castello, 1966	x		x			x	CPUFMT1869
Apteronoidae							
Apteronotus albifrons (Linnaeus, 1766)			x				CPUFMT1790
Sternarchorhynchus curvirostris (Boulenger, 1887)	x						CPUFMT1667
Rhamphichthyidae							
Gymnorhamphichthys hypostomus Ellis, 1912					x	x	CPUFMT1833
Hypopomidae							
Brachyhypopomus sp.	x		x			x	CPUFMT1707
Gymnotidae							
Gymnotus inaequilabiatus (Valenciennes, 1839)				x			CPUFMT1757
CYPRINODONTIFORMES							
Rivulidae							
Melanorivulus sp.		x					CPUFMT1842
PERCIFORMES							
Cichlidae							
Crenicichla semifasciata (Heckel, 1840)		x					CPUFMT1612
Crenicichla vittata Heckel, 1840					x		CPUFMT1624
Aequidens plagiozonatus Kullander, 1984		x		x	x	x	CPUFMT1614
Cichlasoma dimerus (Heckel, 1840)			x				CPUFMT1595
Richness	**27**	**18**	**33**	**22**	**17**	**33**	

DISCUSSION

Other studies in the Cerrado region (Lemes and Garutti 2002; Verissimo *et al*. 2005; Aquino *et al*. 2009; Machado *et al*. 2011; Casatti *et al*. 2013) obtained the same results regarding the predominance of the orders Characiformes followed by Siluriformes. These authors emphasized that, in streams, the family Characidae stands out for having the greatest number of species, corroborating the results found in the urban streams of Rondonópolis. The fish inventory conducted by Castro and Vizzoto (2013) in the Vermelho River, the main river into which flow the streams included in this study, confirmed the predominance of Characiformes in large rivers of the Upper Paraguay River Basin.

The diversity and composition of fish from streams is not fully known (Casatti 2001), however the predominance of Characiformes and Siluriformes in lotics reflects its greater representation in the neotropical ichthyofauna of freshwater systems (Lowe-McConnell 1999; Castro 1999), the same way as in the Paraná Basin (Yzel 2008; Yzel and Lima-Junior 2009; Gubiani*et al*. 2010; Pereira *et al*. 2014), Paraguay Basin (Britski *et al*. 2007; Teresa *et al*. 2010; Pacheco *et al*. 2012) and Uruguay Basin (Teixeira-de Mello *et al*. 2011).

Even in the case of streams within urban stretches, species richness was considered relatively high, representing 21% of the species (*n*=269) described for the Pantanal (Britski *et al*. 2007) and stated for the Upper Paraguay River Basin (Yzel *et al*. 2007; Polaz *et al*. 2014), to the basin of the Paraguay and Paraná rivers (Cionek *et al*. 2012). This rich fish community composition associated with dominance of small individuals (Oliveira *et al*. 2014) corroborate with the considerations of Castro (1999) which highlights the small size of the fish, the relatively high degree of endemism and the occupation of very specific microhabitats as factors that further accentuate the need to establish strategies for the conservation of streams. Thus, since urbanization pressure in this region is large, this checklist is essential to support the adoption of mitigating measures for reducing the impact of environmental degradation and thus ensure that these streams continue to support a diverse ichthyofauna.

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