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Abstract: In the Toledo metropolitan area there are many small headwater streams which suffer the influence of the urban development (pollution, deforestation, introduction of non-native species). The list of fish species in these sites is important for the knowledge on biodiversity in similar environments. Samples were taken bimonthly from October 2007 to February 2009 in three sites (headwater, middle and mouth) along of the three streams within urbanization gradient in the city of Toledo. A total of 27 fish species ascribed to 18 Genera, six Orders and 11 Families were collected, among which four species are non-native species, and seven are probably new to the science.

Introduction

The São Francisco Verdadeiro River drains 2,219.1 km^2, including eleven cities in the west of the state of Paraná, Brazil. Its sources are located in the city of Cascavel, and it runs 262 km before reaching the reservoir of Itaipu, at the Paraná River. The landscape of the drainage basin is a mosaic of farmland and urban areas and there are 10,000 rural properties along its course, especially in the region of Cascavel and Toledo cities. Many small streams (1st order, *sensu* Strahler 1957) has its origin next to or within the urban perimeter of the city of Toledo, and are affected by urbanization and agriculture, showing different degrees of impacts in these environments, especially in the physical, chemical, and biological features.

Urban development has been the main cause of flow changes, including changes in hydrological processes such as impermeability of the catchment, until local precipitation, resulting in a decrease in soil infiltration and an increase in surface runoff (Dunne and Leopold 1978). In addition, changes in stability and morphology of the channel, and effects on biological and ecological processes, such as reduced biotic richness, and dominance of tolerant species were also noticed (Paul and Meyer 2001, Meyer *et al.* 2005).

The ecological implications of urbanization are not well known on fish assemblage (Mulholland and Lenat 1992, Fitzpatrick *et al.* 2004). The lack of studies in Brazilian urban streams, mainly on fish assemblage composition and structure (except Oliveira and Benneman 2005; Vieira and Shibatta 2007; Cunico *et al*. 2006; 2009) hinder possible management actions in these environments. Thus, this study provides a list of fish species from three small urban headwater streams in the city of Toledo, state of Paraná.

Material and Methods

Study area

This study was conducted in three streams (Panambi, Jacutinga and Pinheirinho; Figure 1) of first order (Strahler 1957), located within the urban perimeter of the city of Toledo, state of Paraná, belonging to the Paraná III basin (Suderhsa 2009). This basin is composed of several sub-basins, among those, the sub-basin of the São Francisco Verdadeiro River, which is formed by several rivers and streams which due to the anthropogenic activities constitute a highly impacted area.

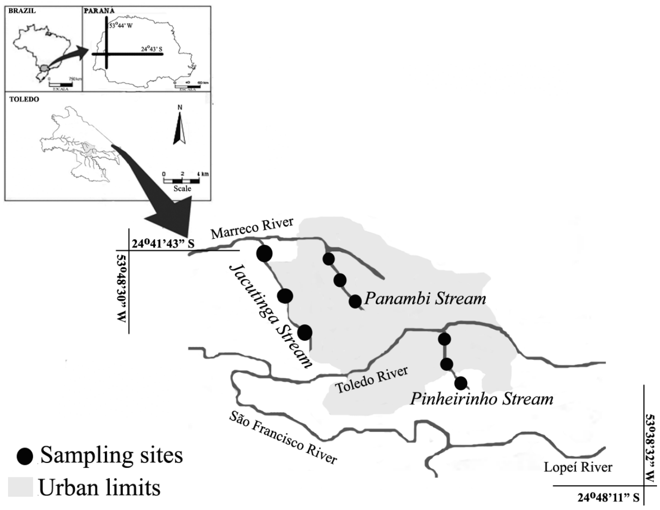

Figure 1. Location of the studied basin.

The sources of the Panambi Stream are located downtown (Figure 1), and their margins are fully occupied by residences, receiving domestic and industrial sewage. On the other hand, the sources of the Pinheirinho Stream are located outside of the city (Figure 1), suffering influence of the agriculture in their margins. The middle portion starts to be impacted by residences, while the Jacutinga Stream shows less impact of them, but some other impacts are also relevant such as aquaculture and agriculture (Figure 1). Some physical features and geographic coordinates of the streams are showed in the Table 1.

Fish sampling

Fish were sampled bimonthly from October 2007 to February 2009 in three different sites (headwater, middle and mouth) along of the three streams within urbanization gradient in the city of Toledo. Fishes were collected with permission of the IAP (*Instituto Ambiental do Paraná*, *ofício No. 755/2008*). The sampling lengths at each site reached 40 m long, which is slightly longer than the 35 times stream width recommended by Simonson and Lyons (1995). Fishes were caught by electrofishing, which is efficiently for collecting small fish species (Severi *et al.* 1995) in lotic environments (Mazzoni *et al.* 2000). The electrofishing equipment was powered by a portable generator (HONDA, 2.5 kW, 220 V, 3-4 A) connected to a DC transformer, then two electrified net rings (anode and cathode). Output voltage varied from 400 to 600 V. Each reach was fished three times (applying a constant fishing effort, ≈ 30 min for each fishing removal) from downstream to upstream by four people following the protocol suggested by Esteves and Lobón-Cerviá (2001). The two edges of the sampled area were blocked by a closing net (0.5 cm of mesh size), so that no fish could get in or out of the sampled site. Collected fish were identified in accordance to Graça and Pavanelli (2007), except to *Trychomycterus* species and *Ancistrus* sp. The classification of species is presented according to Eschmeyer (2009) for superior categories and Reis *et al.* (2003) for Neotropical families. Voucher specimens, except for *Crenicichla niederleinii* (Holmberg, 1891) and *Tilapia rendalli* (Boulenger, 1897) only one specimen collected, were deposited in the fish collection of *Nupélia* (*Núcleo de Pesquisas em Limnologia, Ictiologia, e Aquicultura*), of the Universidade Estadual de Maringá, Brazil, disponible at: *www.nupelia.uem.br/colecao*.

Results and Discussion

A total of 5,977 individuals were collected in the whole period, belonging to 27 species, which are distributed in 18 genera, 11 families and six orders (Table 2). Four of these species collected were considered non-natives and seven are probably new species (four species were not registered in the upper Paraná River basin; see Table 2). The most representative orders were Characiformes (29.6%), with three families and eight species, followed by Siluriformes (25.9%), with four families and seven species. The dominance of Characiformes and Siluriformes (55.5%) is a common trend in inland aquatic environments in the Neotropical region (Lowe-McConnell 1999). The families with more species numbers were Cichlidae (22.2%) and Characidae (14.8%), totaling 37.0% of the collected species.

The species with the higher number of collected specimens were *Phalloceros harpagos* Lucinda, 2008 (33.6%) followed by *Astyanax* aff. *paranae* Eigenmann, 1914 (18.2%) and *Astyanax* aff. *fasciatus* (Cuvier, 1819) (9.3%). Castro (1999) affirms that predominance of small size fishes is the only general pattern with diagnosis value to the ichthyofauna of South American streams. The number and composition of species change in accordance with the size and site of the stream, region and basin (Oliveira and Bennemann 2005).

Notwithstanding of the alterations of the environment, the native species have still been finding habitats for their survival, however, the abundance of exotic species can be a sign that they are competing for the exploitation of the environment and its resources (Vieira and Shibatta 2007). This success of non-native species upon the native species, allied to the resistance to high temperatures, salinity and low concentrations of dissolved oxygen of these species, are important traits for the success in altered environments (Moyle and Cech Jr. 1996). The non-native species found here, *Oreochromis niloticus* (Linnaeus, 1758), *Poecilia reticulata* Peters, 1859, *Tilapia rendalli* (Boulenger, 1897) and *Xiphophorus hellerii* Heckel, 1848, were the same ones that Cunico *et al.* (2009) found at the urban streams of Maringá. However, in the Toledo urban streams the more common species (total number) were *Phalloceros harpagos* versus *Poecilia reticulata* in the urban streams of Maringá. Urban streams are susceptible to invasion by non-native fish species (Vieira & Shibatta 2007; Cunico *et al.* 2009). Moreover, the presence of pollutant sources and other impacts, mainly anthropogenic activities, provide the reduction of the number of species and the increase of the density of resistant species to the environmental variations (Reash and Berra 1987), same tendency was observed by Cunico *et al.* (2006) for urban streams in the city of Maringá.

For upper Paraná River basin, Langeani *et al.* (2007) listed 360 species (50 probably new species). However, our studies in the Toledo urban streams indicated the presence of additional putative new species (three *Trichomycterus*

Table 1. Physical features of the sampled sites in three urban streams, Paraná III Basin, state of Paraná. Panambi (Pan), Jacutinga (Jac), Pinheirinho (Pin), Headwater (H), Middle (Mi) and Mouth (Mo).

Site	Longitude (W)	Latitude (S)	Altitude (m)	Width (m)	Depht (m)	Predominant Substrate	Riparian Vegetation
PanH	53°44'53"	24°43'04"	547	2.61	0.23	Sand	between 6 and 12 m
PanMi	53°45'08"	24°42'25"	536	4.00	0.28	Sand	< 6 m; restritic or absence
PanMo	53°45'25"	24°41'55"	526	4.53	0.24	Sand	< 6 m; restritic or absence
JacH	53°46'22"	24°43'15"	551	1.20	0.10	Clay	between 12 and 18 m
JacMi	53°46'21"	24°42'56"	542	2.66	0.11	Sand	between 6 and 12 m
JacMo	53°46'11"	24°41'58"	523	2.75	0.28	Sand	< 6 m; restritic or absence
PinH	53°42'33"	24°45'23"	543	1.93	0.12	Sand	between 6 and 12 m
PinMi	53°42'48"	24°44'46"	510	2.14	0.15	Sand	< 6 m; restritic or absence
PinMo	53°42'55"	24°44'05"	485	2.75	0.32	Sand	< 6 m; restritic or absence

and one *Ancistrus*) not listed by those authors or by Graça and Pavanelli (2007). Additionally, our results corroborate the hypothesis raised for Maier *et al.* (2008) about the unsatisfactory knowledge of the headwater fish community from the upper Paraná River as a whole. The recent increment in the fish samples in the upper Paraná River basin has showing the highest fish diversity in this basin, mainly in small tributaries (see Maier *et al.* 2008; Cunico *et al.* 2009). The species list presented here showed that small tributaries have a high diversity of fish species that are potentially not well studied in terms of their taxonomical, genetically, ecological and biological traits.

Table 2. List of fish species and their respective abundances from Toledo's urban streams. The numbers and the respective streams are: 1. Jacutinga; 2. Panambi; 3. Pinheirinho. The regional popular name of each species is provided between quotation marks. Asterisk indicates species not registered in other studies, § indicates non-native species and † indicates species uncatalogued.

Group	Species	Vulgar name	1	2	3	Total No	Voucher No
Characiformes							
Crenuchidae	*Characidium* aff. *zebra* Eigenmann, 1909	"mocinha"	103	7	88	198	NUP 8537
Characidae *insert sedis*	*Astyanax altiparanae* Garutti & Britski, 2000	"tambiú"	0	20	23	43	NUP 8556
	Astyanax bockmanni Vari & Castro, 2007	"lambari"	119	20	0	139	NUP 8529
	Astyanax aff. fasciatus (Cuvier, 1819)	"lambari-rabo-vermelho"	19	43	492	554	NUP 8548
	Astyanax aff. paranae Eigenmann, 1914	"lambari"	11	56	1021	1088	NUP 8540
Erythrinidae	*Hoplias* sp. 1	"traíra"	2	0	1	3	NUP 8528
	Hoplias sp. 2	"traíra"	4	4	1	9	NUP 8510
	Hoplias sp. 3	"traíra"	35	3	4	42	NUP 8509
Siluriformes							
Trichomycteridae	*Trichomycterus* sp. 1 *	"candirú"	33	3	20	56	NUP 8520
	Trichomycterus sp. 2 *	"candirú"	1	1	273	275	NUP 8524
	Trichomycterus sp. 3 *	"candirú"	25	0	13	38	NUP 8521
Loricariidae							
Hypostominae	*Ancistrus* sp. *	"cascudo-barbudo", "roseta"	1	0	0	1	NUP 8532
	Hypostomus ancistroides (Ihering, 1911)	"cascudo"	115	295	25	435	NUP 8511
Heptapteridae	*Heptapterus mustelinus* (Valenciennes, 1835)	"bagre-pedra"	0	0	14	14	NUP 8547
	Rhamdia quelen (Quoy & Gaimard, 1824)	"bagre", "jundiá"	13	341	0	354	NUP 8563
Gymnontiformes							
Gymnotidae	*Gymnotus pantanal* Fernandes *et al.*, 2005	"morenita", "tuvira"	98	7	14	119	NUP 9290
	Gymnotus sylvius Albert & Fernandes-Matioli, 1999	"morenita", "tuvira"	51	208	56	315	NUP 9291
Synbranchiformes							
Synbranchidae	*Synbranchus marmoratus* Bloch, 1794	"muçum"	26	20	9	55	NUP 8566
Cyprinodontiformes							
Poeciliidae	*Phalloceros harpagos* Lucinda, 2008	"barrigudinho", "guaru"	1192	692	123	2007	NUP 8561
	Poecilia reticulata Peters, 1859 §	"barrigudinho", "guaru"	6	1	9	16	NUP 8527
	Xiphophorus hellerii Heckel, 1848 §	"espadinha"	0	9	0	9	NUP 8560
Perciformes							
Cichlidae	*Cichlasoma paranaense* Kullander, 1984	"carazinho"	5	22	3	30	NUP 8541
	Crenicichla britskii Kullander, 1982	"joaninha"	130	0	0	130	NUP 8531
	Crenicichla niederleinii (Holmberg, 1891) †	"joaninha"	1	0	0	1	---
	Geophagus aff. *brasiliensis* (Quoy & Gaimard, 1824)	"cará"	0	0	1	1	NUP 8545
	Oreochromis niloticus (Linnaeus, 1758) §	"tilápia"	2	32	10	44	NUP 8544
	Tilapia rendalli (Boulenger, 1897)	"tilápia"	0	0	1	1	---
	Total number		**1992**	**1784**	**2201**	**5977**	
	Richness		**22**	**19**	**21**	**27**	

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