

The stream fish fauna from three regions of the Upper Paraná River basin

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FAGUNDES, D.C., LEAL, C.G., CARVALHO, D.R., JUNQUEIRA, N.T., LANGEANI, F., POMPEU, P.S. The stream fish fauna from three regions of the Upper Paraná River basin. Biota Neotropica. 15(2): 1–8. <http://dx.doi.org/10.1590/1676-06032015018714>

Abstract: This study aimed to conduct an inventory of fish assemblages in small streams that are tributaries of large reservoirs in three previously unstudied regions of the Upper Paraná River basin. We sampled 117 streams from 1st to 3rd order in Araguari (Nova Ponte hydropower plant reservoir), Paranaíba (São Simão reservoir) and Grande (Volta Grande reservoir) drainages. In total, 20,696 specimens belonging to 100 species, 53 genera, 20 families and six orders were collected. Of these, 11,530 specimens and 41 species were recorded in Araguari, whereas 17 were exclusive to this drainage. In Grande drainage, 3,537 individuals belonging to 41 species (11 exclusive) and in Paranaíba, 5,629 specimens and 67 species (38 exclusive) were sampled. The mean richness per stream was 6.7 for Grande, 9.0 for Araguari and 10.9 for Paranaíba drainage. The predominant orders were Characiformes, 48% of the total richness, and Siluriformes, 36%. Three species were diagnosed as new: *Astyanax* sp. 1 (Grande and Paranaíba), *Astyanax* sp. 2 and *Astyanax* sp. 3 (both from Araguari), all from *scabripinnis* group. Another three were considered potentially new: *Characidium* sp. 1, *Characidium* sp. 2 and *Rhamdiopsis* sp. Among all records, eight species are not native from the Paraná basin: the exotics *Oreochromis niloticus* and *Tilapia rendalli* and the allochthonous *Cyphocharax gillii*, *Hoplerethrinus unitaeniatus*, *Knodus moenkhausii*, *Poecilia reticulata*, *Roeboides descavadensis* and *Trichomycterus brasiliensis*. This study fills part of the existing knowledge gap about fish from small streams of the Paraná basin. Inventories of the fish fauna from these low-order water courses are important because they highlight their biodiversity relevance, including a significant number of unknown species. Thus, this study contributes to a better knowledge of the stream fish fauna of the upper Paraná River basin, as well as contribute to the establishment of strategies for conservation of this important component of aquatic biodiversity.

Keywords: fish, species inventory, new species.

FAGUNDES, D.C., LEAL, C.G., CARVALHO, D.R., JUNQUEIRA, N.T., LANGEANI, F., POMPEU, P.S. A ictiofauna de riachos de três regiões do alto rio Paraná. Biota Neotropica. 15(2): 1–8. <http://dx.doi.org/10.1590/1676-06032015018714>

Resumo: Este trabalho teve como objetivo realizar um inventário das assembleias de peixes em pequenos riachos afluentes de grandes reservatórios do alto rio Paraná, em três regiões até então desconhecidas pela literatura. Foram amostrados 117 riachos de 1^a a 3^a ordens nas bacias dos rios Araguari (na bacia de drenagem do reservatório de Nova Ponte), Paranaíba (reservatório de São Simão) e Grande (reservatório de Volta Grande). No total foram capturados 20.696 exemplares pertencentes a 100 espécies, seis ordens, 20 famílias e 53 gêneros. Destes, 11.530 exemplares e 41 espécies foram registradas na bacia do Araguari, sendo que 17 dessas espécies são exclusivas. Na bacia do rio Grande, foram registrados 3.537 exemplares pertencentes a 41 espécies (11 exclusivas) e na bacia do Paranaíba, foram registrados 5.629 exemplares e 67 espécies (38 exclusivas). A riqueza média por riacho foi de 6.7 para os riachos da bacia do rio Grande, 9.0 para os riachos da bacia do Araguari e 10.9 para os riachos da bacia do rio Paranaíba. As ordens predominantes foram Characiformes, com 48% da riqueza total e Siluriformes, com 36%. Três espécies pertencentes ao grupo *scabripinnis* foram diagnosticadas como novas: *Astyanax* sp. 1 (Grande e Paranaíba), *Astyanax* sp. 2 (Araguari) e *Astyanax* sp. 3 (Araguari). Outras três foram consideradas como potencialmente novas: *Characidium* sp. 1, *Characidium* sp. 2 e *Rhamdiopsis* sp. Entre todos os registros, oito espécies não são nativas da bacia do Paraná: as exóticas

Oreochromis niloticus e *Tilapia rendalli* e as alóctones *Cyphocharax gillii*, *Hoplerythrinus unitaeniatus*, *Knodus moenkhausii*, *Poecilia reticulata*, *Roeboides descavadensis* e *Trichomycterus brasiliensis*. Este estudo preenche parte da lacuna de conhecimento existente sobre peixes de pequenos riachos da bacia do Paraná. Os inventários sobre a fauna de peixes em riachos de pequena ordem são importantes, pois evidenciam a ocorrência de grande diversidade, incluindo um número significativo de espécies ainda não descritas. Dessa forma, esse estudo contribui para um melhor conhecimento da fauna de peixes de riachos pertencentes à bacia do alto rio Paraná, além de colaborar para o estabelecimento de estratégias para conservação deste importante componente da biodiversidade aquática.

Palavras-chave: peixes, inventário, espécie nova.

Introduction

Vertebrates are represented by approximately 55,000 species of which more than 31,000 are fish (IUCN 2008; Froese & Pauly 2009; Eschmeyer & Fong 2010). Neotropical freshwater ecosystems encompass a great part of this diversity, namely 4,475 valid species and about other 1,550 yet to be described (Reis et al. 2003). Therefore this region is considered to have the most diverse freshwater fish fauna in the world (Junk 2007). Brazil covers most of the Neotropical region, and its ichthyofauna hosts more than 3,000 freshwater species (Froese & Pauly 2014). This is due to, among other factors, the country's vast extension and complex hydrological network including some of the largest river drainages in the world.

The Paraná River basin is the second largest in drainage area in Brazil (Latrubesse et al. 2005). The upper portion of the basin is considered the best studied region in terms of its ichthyofauna, however this knowledge is still insufficient and several regions remain completely unknown. Therefore the present study aimed to present the results of an inventory conducted in small streams draining to three large reservoirs in the Upper Paraná, in areas thus far unstudied. The information presented here can be used to inform management and conservation strategies.

Materials and Methods

1. Study Area

The Upper Paraná River encompasses the Paraná River basin upstream the former Salto de Sete Quedas (Bonetto 1986). This portion of the basin represents 891,000 km² (10.5% of Brazil's total area) (Agostinho et al. 2003) and includes important tributaries such as the Araguari, Grande, Paranaíba, Paranapanema and Tietê, and the first three were included in the present study. The Araguari River is a left bank tributary of the Paranaíba River and has its headwaters in the Parque Nacional da Serra da Canastra, São Roque de Minas municipality, Minas Gerais state. This tributary is 475 km of length and covers 21,856 km² of drainage area (Baccaro et al. 2004). The headwaters of the Grande River are in the Serra da Mantiqueira, Bocaina de Minas municipality. Approximately 86,500 km² of its total 143,000 km² drainage area is within Minas Gerais state limits. The Paranaíba has its headwaters in the Serra da Mata da Corda, 1,100 m above sea level and its drainage area encompasses 222,711 km², with ca 30% in Minas Gerais state. Together, the rivers Paranaíba and Grande form the Paraná River.

This study was carried out in 117 streams of 1st to 3rd order (according to Strahler 1957) belonging to Araguari (38 streams), Paranaíba (39 streams) and Grande river (40 streams) drainages (Figure 1).

1.1. Fish Sampling and Identification. Stream sampling was carried out during the dry season, in September 2009 (Araguari), 2011 (Grande), 2012 (Paranaíba) and 2013 (resampling of Araguari streams). The length of each stream site sampled was 40 times its mean width, with a minimum length of 150 m (Kaufmann et al. 1999). Each stream was sampled for two hours by three people using mainly semicircular hand nets (80 cm of diameter, 1 mm of mesh size) and seines when possible (4 m long, 2 m high, 5 mm of mesh size). All catches were made during daylight hours. Specimens were killed in an anesthetic solution of clove oil and then fixed in 10% formalin. In the laboratory, all sampled fishes were transferred to 70° GL alcohol and identified to species level, by means of identification key (Graça & Pavanelli 2007) and expert (Francisco Langeani). Voucher specimens of all species are deposited at the following fish collections: Coleção de Ictiologia da Universidade Federal de Lavras (CIUFLA), Coleção do Departamento de Zoologia da Universidade Estadual Paulista, São José do Rio Preto campus (DZSJRP), Museu de Ciências e Tecnologia da PUCRS (MCP), Museu de Zoologia da Universidade de São Paulo (MZUSP), Museu Paraense Emilio Goeldi (MPEG) and Coleção Ictiológica do Nupélia (NUP), Universidade Estadual de Maringá (Table 1).

Results and Discussion

In total we collected 20,696 specimens belonging to 100 species, 53 genus, 20 families and six orders. Araguari accounted for 11,530 specimens and 41 species whereas 17 species were exclusive to this drainage. Grande drainage was represented by 3,537 individuals belonging to 41 species (11 exclusive) and the Paranaíba by 5,629 specimens and 67 species (38 exclusive). Paranaíba showed the highest mean richness per stream, 10.9, followed by Araguari, 9.0 and Grande, 6.7 (Table 1).

Characiformes and Siluriformes orders represented the majority of the species richness, 48% and 36% respectively, reflecting a well known pattern recognized for South American rivers (Lowe-McConnell 1987). Langeani et al. (2007) recorded 310 species included in 11 orders for the Upper Paraná basin, with 80% represented by Characiformes and Siluriformes, a number similar to our findings. Likewise Alves et al. (2007) found a predominance of Characiformes (47%) and Siluriformes (32%) in the Minas Gerais portion of the Upper Paraná basin.

At the family level, the Characidae was the best represented in this study. Other studies also found the same pattern (Castro et al. 2003; 2004; Shibatta et al. 2007). The Characidae is one of the richest families among the Neotropical freshwater fish fauna (Reis et al. 2003), and present a wide range of feeding habits and habitat uses (Kavalco & Pazza 2007).

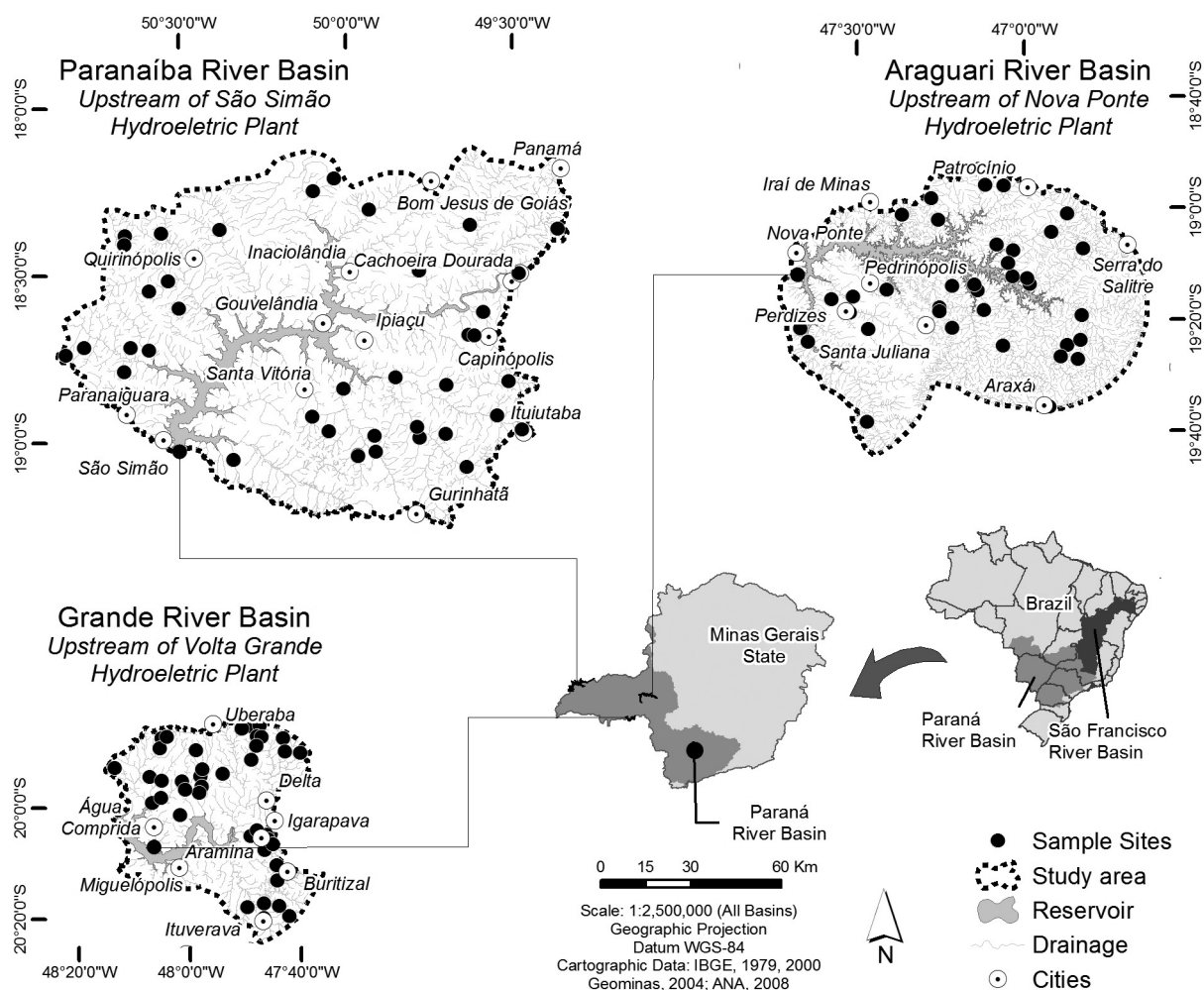


Figure 1. Map of the study area showing the location of the 117 streams in the Upper Paraná River basin.

The *Astyanax scabripinnis* group is particularly abundant and widespread in small streams in several Brazilian river basins (Bertaco & Lucena 2006), including the Upper Paraná River basin (Castro & Casatti 1997; Pavanelli & Caramaschi 1997). In the present study three species within the *scabripinnis* group were identified as probably new: *Astyanax* sp. 1 (Grande and Paranaíba), *Astyanax* sp. 2 (Araguari) and *Astyanax* sp. 3 (Araguari). Besides these, another three species were considered potentially new: *Characidium* sp. 1, *Characidium* sp. 2 e *Rhamdiopsis* sp.

Besides being a well studied region, the Upper Paraná still hosts several new species, some of them recently discovered and described. Langeani et al. (2007) listed 50 new species for the region, whereas 16 were formally described since then and another 34 await the same process (*Leporinus piavussu* Britski, Birindelli & Garavello 2012; *Astyanax bockmanni* Vari & Castro 2007; *Hemigrammus parana* Marinho, Carvalho, Langeani & Tatsumi 2008; *Characidium heirmostigmata* Graça & Pavanelli 2008; *Characidium xanthopterum* Silveira, Langeani, Graça, Pavanelli & Buckup 2008; *Apterotonotus acidops* Triques 2011; *Gymnorhamphichthys britskii* Carvalho, Ramos & Albert 2011; *Rhinolekos britskii* Martins, Langeani & Britskii 2011; *Hypostomus multidentis* Jerep, Shibatta & Zawadzki 2007; *Harttia absaberi* Oyakawa, Fichberg & Langeani 2013; *Neoplecostomus corumba* Zawadzki, Pavanelli

& Langeani 2008; *Neoplecostomus selenae* Zawadzki, Pavanelli & Langeani 2008; *Neoplecostomus yapo* Zawadzki, Pavanelli & Langeani 2008; *Phalloceros harpagos* Lucinda 2008; *Phalloceros reisi* Lucinda 2008; *Laetacara araguaiae* Ottoni & Costa 2009). In addition to the new species mentioned by Langeani et al. (2007), another 29 were also described for the region (*Hyphessobrycon uaiso* Carvalho & Langeani 2013; *Hyphessobrycon vinaceus* Betarco, Malabarba & Dergam 2007; *Corumbataia britskii* Ferreira & Ribeiro 2007; *Hisonotus piracanjuba* Martins & Langeani 2012; *Microlepidogaster dimorpha* Martins & Langeani 2011; *Microlepidogaster arachas* Martins, Calegari & Langeani 2012; *Microlepidogaster longicollis* Calegari & Reis 2010; *Otothyropsis biannicus* Calegari, Lehmann & Reis 2013; *Otothyropsis Polyodon* Calegari, Lehmann & Reis 2013; *Rhinolekos schaeferi* Martins & Langeani 2011; *Rhinolekos garavello* Martins & Langeani 2011; *Hypostomus denticulatus* Zawadzki, Weber & Pavanelli 2008; *Hypostomus heraldoi* Zawadzki, Weber & Pavanelli 2008; *Neoplecostomus bandeirante* Roxo, Oliveira & Zawadzki 2012; *Neoplecostomus botucatu* Roxo, Oliveira & Zawadzki 2012; *Neoplecostomus langeanii* Roxo, Oliveira & Zawadzki 2012; *Iheringichthys syi* Azpelicueta & Britskii 2012; *Trichomycterus perkosi* Datovo, Carvalho & Ferrer 2012; *Trichomycterus pirabittira* Barbosa & Azevedo Santos 2012; *Trichomycterus piratymbara* Katz, Barbosa & Costa 2013; *Trichomycterus septemradius* Katz,

Table 1. Fish species sampled in Upper Paraná River basin streams. N = number of individuals, CI-UFLA = voucher specimens deposited at Coleção de Peixes da Universidade Federal de Lavras (UFLA), DZSJRP = Coleção do Departamento de Zoologia de São José do Rio Preto, MCP = Museu de Ciências e Tecnologia da PUCRS, MPEG = Museu Paraense Emílio Goeldi, MZUSP = Museu de Zoologia da Universidade de São Paulo, NUP = Coleção ictiológica do Nupélia. * = allochthonous species, ** = exotic species, *** = migratory species, **** = probably nem species, X = specimens that couldn't be deposited in a scientific collection because they were used in stable isotopes study, in this case they were identified through photos taken in the field.

TAXON (Catalog of Fishes)	Upper Paraná River basin			Collection	Voucher
CHARACIFORMES	Araguari	Grande	Paranaíba		
Acestrorhynchidae					
<i>Acestrorhynchus lacustris</i> (Lütken, 1875)	1	-	5	CIUFLA	0460/X
Anostomidae					
<i>Leporinus friderici</i> (Bloch, 1794) ***	-	-	1		X
<i>Leporinus lacustris</i> Amaral Campos, 1945	-	-	1		X
<i>Leporinus microphthalmus</i> Garavello, 1989	26	-	3	CIUFLA	0483/0841
<i>Leporinus octofasciatus</i> Steindachner, 1915	-	-	2	CIUFLA	0842
<i>Leporinus paranensis</i> Garavello & Britski, 1987	-	-	2	CIUFLA	0843
<i>Leporinus piavussu</i> Britski, Birindelli & Garavello, 2012	-	-	1		X
<i>Leporinus striatus</i> Kner, 1858	-	-	2	CIUFLA	0844
Characidae					
<i>Aphyocharax dentatus</i> Eigenmann & Kennedy, 1903	-	-	5		X
<i>Astyanax altiparanae</i> Garutti & Britski, 2000	44	29	95	CIUFLA	0464/0769/0749/0807
<i>Astyanax bockmanni</i> Vari & Castro, 2007	-	67	156	CIUFLA	0750/0808
<i>Astyanax fasciatus</i> (Cuvier, 1819)	31	18	315	CIUFLA	0770/0751/0809
<i>Astyanax</i> sp. 1****	-	838	192	CIUFLA	0752/0810
<i>Astyanax</i> sp. 2****	1002	-	-	CIUFLA	0463/0771
<i>Astyanax</i> sp. 3****	3347	-	-	CIUFLA	0465/0772
<i>Bryconamericus</i> cf. <i>stramineus</i> Eigenmann, 1908	-	1	-	CIUFLA	0881
<i>Bryconamericus stramineus</i> Eigenmann, 1908	5	12	4	CIUFLA	0467/0773/0754/0812
<i>Bryconamericus turiuba</i> Langeani, Lucena, Pedrini & Tarelho-Pereira, 2005	61	110	-	CIUFLA	0774/0755
<i>Brycon orbignyanus</i> (Valenciennes, 1850) ***	-	3	1	CIUFLA	0753/0811
<i>Glandulocaudinae</i> sp.	1	-	-	MZUSP	114314
<i>Hasemania</i> sp.	2	-	32	CIUFLA	0783/822
<i>Hemigrammus parana</i> Marinho, Carvalho, Langeani & Tatsumi, 2008	308	-	-	CIUFLA	0784
<i>Hyphessobrycon eques</i> (Steindachner, 1882)	-	-	8	CIUFLA	0826
<i>Knodus moenkhausii</i> (Eigenmann & Kennedy, 1903) *	528	18	2517	CIUFLA	0481/0789/ CIUFLA 0734/0839
<i>Moenkhausia intermedia</i> Eigenmann, 1908	-	-	1	CIUFLA	0845
<i>Moenkhausia sanctaefilomenae</i> (Steindachner, 1907)	-	-	14	CIUFLA	0846
<i>Oligosarcus</i> cf. <i>planaltinae</i>	6	-	-	CIUFLA	0486/0792
<i>Oligosarcus pinto</i> i Amaral Campos, 1945	-	17	-	CIUFLA	0736
<i>Piabina argentea</i> Reinhardt, 1867	142	24	145	CIUFLA	0489/0795/0738/0849 DZSJRP 20030/20031
<i>Roeboides descalvadensis</i> Fowler, 1932*	-	-	5	CIUFLA	0855
<i>Serrapinus</i> sp. 1	-	-	40	CIUFLA	0861 DZSJRP 18692/18696
<i>Serrapinus</i> sp. 2	-	-	127	CIUFLA	0862 DZSJRP 18709
<i>Triportheus nematurus</i> (Kner, 1858)	-	-	12	CIUFLA	0858
Crenuchidae					
<i>Characidium</i> cf. <i>zebra</i> Eigenmann, 1909	4	-	-	CIUFLA	0776
<i>Characidium gomesi</i> Travassos, 1956	30	41	45	CIUFLA	0777/0757/0814
<i>Characidium</i> sp. 1****	-	76	-	CIUFLA	0863
<i>Characidium</i> sp. 2****	141	-	-	CIUFLA	0469/0778
<i>Characidium xanthopteron</i> Silveira, Langeani, da Graça, Pavanelli & Buckup, 2008	20	-	-	CIUFLA	0471

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Table 1. Continued.

TAXON (Catalog of Fishes)	Upper Paraná River basin			Collection	Voucher
CHARACIFORMES	Araguari	Grande	Paranaíba		
<i>Characidium zebra</i> Eigenmann, 1909	-	-	306	CIUFLA	0815
Curimatidae					
<i>Cyphocharax gilli</i> Eigenmann & Kennedy, 1903*	-	-	4		X
<i>Steindachnerina insculpta</i> (Fernández-Yépez, 1948)	-	-	10	CIUFLA	0856
Erythrinidae					
<i>Hoplerethrinus unitaeniatus</i> (Spix & Agassiz, 1829)*	-	1	-	CIUFLA	0766
<i>Hoplias</i> aff. <i>malabaricus</i> (Bloch, 1794)	6	-	1	CIUFLA	0476/0785/0825
<i>Hoplias intermedius</i> (Günther, 1864)	3	3	3	CIUFLA	0475/0763/0824
Lebiasinidae					
<i>Pyrrhulina australis</i> Eigenmann & Kennedy, 1903	-	12	4	CIUFLA	0740/0852
Parodontidae					
<i>Apareiodon</i> cf. <i>piracicabae</i> Eigenmann, 1907	-	-	5	CIUFLA	0804
<i>Apareiodon ibitiensis</i> Amaral Campos, 1944	158	32	119	CIUFLA	0461/0768/0747/0805
<i>Parodon nasus</i> Kner, 1859	6	-	-	CIUFLA	0487/0793
CYPRINODONTIFORMES					
Poeciliidae					
<i>Phalloceros harpagos</i> Lucinda, 2008	2017	2	-	CIUFLA	0488/0794/0737
<i>Poecilia reticulata</i> Peters, 1859*	43	532	112	CIUFLA	0490/0796/0739/0851
Rivulidae					
<i>Rivulus apiamici</i> Costa, 1989	-	-	11	CIUFLA	0854
GYMNOTIFORMES					
Gymnotidae					
<i>Gymnotus carapo</i> Linnaeus, 1758	-	-	1	CIUFLA	0820
<i>Gymnotus</i> cf. <i>inaequilabiatus</i> Valenciennes, 1839	-	1	-	CIUFLA	0760
<i>Gymnotus sylvius</i> Albert & Fernandes-Matioli, 1999	16	16	3	CIUFLA	0474/0782/0761/0821
Sternopygidae					
<i>Eigenmannia trilineata</i> López & Castello, 1966	-	-	7	CIUFLA	0818
<i>Eigenmannia virescens</i> (Valenciennes, 1836)	-	-	3	CIUFLA	0819
<i>Sternopygus macrurus</i> (Bloch & Schneider, 1801)	-	-	1		X
PERCIFORMES					
Cichlidae					
<i>Cichlasoma paranaense</i> Kullander, 1983	9	2	10	CIUFLA	0779/0765/0816
<i>Crenicichla jaguarensis</i> Haseman, 1911	-	-	2	CIUFLA	0817
<i>Geophagus brasiliensis</i> (Quoy & Gaimard, 1824)	47	13	-	CIUFLA	0473/0781/0759
<i>Laetacara araguaiae</i> Ottoni & Costa, 2009	-	-	29	CIUFLA	0840
<i>Oreochromis niloticus</i> (Linnaeus, 1758) **	-	-	81	CIUFLA	0847
<i>Tilapia rendalli</i> (Boulenger, 1897) **	-	1	-	CIUFLA	0744
SILURIFORMES					
Auchenipteridae					
<i>Tatia neivai</i> (Ihering, 1930)	-	1	1	CIUFLA	0764/X
Callichthyidae					
<i>Aspidoras fuscoguttatus</i> Nijssen & Isbrücker, 1976	-	22	208	CIUFLA	0748/0806
<i>Corydoras difluviatilis</i> Britto & Castro, 2002	70	2	-	CIUFLA	0472/0780/0758
Cetopsidae					
<i>Cetopsis gobioides</i> Kner, 1858	-	-	1		X
Heptapteridae					
<i>Cetopsorhamdia iheringi</i> Schubart & Gomes, 1959	45	60	20	CIUFLA	0468/0775/0756/0813
<i>Imparfinis borodini</i> Mees & Cala, 1989	-	3	7	CIUFLA	0732/0836
<i>Imparfinis</i> cf. <i>schubarti</i> Gomes, 1956	-	-	2	CIUFLA	0837
<i>Imparfinis longicauda</i> (Borodin, 1927)	-	-	5		X
<i>Imparfinis schubarti</i> (Gomes, 1956)	3	11	65	CIUFLA	0480/0788/0733/0838
<i>Phenacorhamdia</i> cf. <i>unifasciata</i> Britiski, 1996	-	-	8	CIUFLA	0848
<i>Pimelodella gracilis</i> (Valenciennes, 1835)	-	-	36	CIUFLA	0850
<i>Rhamdia quelen</i> (Quoy & Gaimard, 1824)	37	44	21	CIUFLA	0491/0797/0741/0853
<i>Rhamdiopsis</i> sp. ****	72	13	-	CIUFLA	0479/0798/0742

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Table 1. Continued.

TAXON (Catalog of Fishes)	Upper Paraná River basin			Collection	Voucher
CHARACIFORMES	Araguari	Grande	Paranaíba		
Loricariidae					
<i>Hisonotus piracanjuba</i> Martins & Langeani, 2012	-	-	183	CIUFLA	0823
<i>Hisonotus francirochai</i> (Ihering, 1928)	-	98	-	CIUFLA	0762
				MUP	48252/48253/48254/ 48255/ 48256/48257/48258/ 48259
<i>Hypostomus</i> aff. <i>nigromaculatus</i> Schubart, 1964	-	235	89	CIUFLA	0864/0834
				NUP	16115/16117/16126/ 16130/16132
<i>Hypostomus ancistroides</i> (Ihering, 1911)	-	499	59	CIUFLA	0865/0827
				NUP	16426/16427/16428/ 16429/ 16430/16431/ 16432/16434/ 16435/16436/16437/ 16438
<i>Hypostomus</i> cf. <i>paulinus</i> Ihering, 1905	-	-	56	CIUFLA	0828
<i>Hypostomus</i> cf. <i>topavae</i> Godoy, 1969	-	-	45	CIUFLA	0829
<i>Hypostomus nigromaculatus</i> (Schubart, 1964)	-	198	-	NUP	16112/16113/16114/ 16116/16118/16124/ 16128/16129/16131/ 16134/16135/16136
<i>Hypostomus</i> sp. 1	741	-	-	CIUFLA	0477/0786
<i>Hypostomus</i> sp. 2	109	-	-	CIUFLA	0478/0787
<i>Hypostomus</i> sp. 3	-	-	82	CIUFLA	0830
<i>Hypostomus</i> sp. 4	-	-	148	CIUFLA	0831
<i>Hypostomus</i> sp. 5	-	-	94	CIUFLA	0832
<i>Hypostomus</i> sp. 6	-	-	26	CIUFLA	0833
<i>Hypostomus strigaticeps</i> (Regan, 1908)	-	6	26	CIUFLA	0835
				NUP	16123/16127/16133/ 16433
<i>Microlepidogaster arachas</i> Martins, Calegari & Langeani, 2013	512	-	-	CIUFLA	0484/0790
<i>Neoplecostomus paranensis</i> Langeani, 1990	-	13	-	CIUFLA	0735
<i>Neoplecostomus</i> sp.	79	-	-	CIUFLA	0485/0791
Trichomycteridae					
<i>Trichomycterus</i> aff. <i>brasiliensis</i> Lütken, 1874	-	176	-	CIUFLA	0745
				MPEG	24986
<i>Trichomycterus brasiliensis</i> Lütken, 1874*	258	-	-	CIUFLA	0800
<i>Trichomycterus candidus</i> (Miranda Ribeiro, 1949)	-	284	-	CIUFLA	0746
				MPEG	24979
<i>Trichomycterus</i> sp. 1	1418	-	-	CIUFLA	0493/0801
<i>Trichomycterus</i> sp. 2	177	-	-	CIUFLA	0732/0802
<i>Trichomycterus</i> sp. 3	2	-	-	CIUFLA	0803
SYNBRANCHIFORMES					
Synbranchidae					
<i>Synbranchus marmoratus</i> Bloch, 1795	3	3	4	CIUFLA	0492/0799/0743/0857
Total abundance	11530	3537	5629		
Total richness	41	41	67		
Mean richness per stream	8.97	6.73	10.85		
Exclusive species	17	11	38		

Barbosa & Costa 2013; *Pituna brevisrostrata* Costa 2007; *Melanorivulus faucireticulatus* Costa 2007; *Melanorivulus illuminatus* Costa 2007; *Rivulus giarettai* Costa 2008; *Rivulus formosensis*

Costa 2008; *Simpsonichthys margaritatus* Costa 2011; *Simpsonichthys nigromaculatus* Costa 2007; *Australoheros tavaresi* Ottoni 2012 and *Pimelodus britskii* Garavello & Shibatta 2007.

Among all recorded species, six are considered allochthonous, *i.e.* native to other Neotropical river basins and introduced in the upper Paraná basin. Of these six species, *Cyphocharax gillii* and *Roeboides descavadensis* were collected only in the Paranaíba basin, *Hoplerythrinus unitaeniatus* in the Grande basin and *Trichomycterus brasiliensis* in Araguari basin. On the other hand *Poecilia reticulata* and *Knodus moenkhausii* occurred in each of the drainages. The most abundant allochthonous species, *K. moenkhausii* (especially in the Paranaíba basin) is an opportunistic species that invests much of its energy in reproduction and colonize several environments, including the most degraded (Ceneviva-Bastos & Casatti 2007). *Poecilia reticulata* (the second most abundant allochthonous species) is native to northwestern America (Bisazza 1993) and has been introduced in several regions of the world because of its potential for mosquito control (Araújo et al. 2009). This species also has great ability to increase its population in harsh environments, and is therefore indicative of poor water quality (Araújo 1983).

The two exotic species (*i.e.* native to other continents) recorded in our study area, *Oreochromis niloticus* and *Tilapia rendalli* occurred only in one of the studied drainages each, Grande and Paranaíba respectively. Both species are of medium size and have great commercial value, which probably motivated their introduction. *Oreochromis niloticus* is native to the Nile River basin, East Africa but is largely introduced in tropical and subtropical regions (Carvalho 2006). It was first introduced in northeast Brazil in the 1970s, through the Departamento Nacional de Obras Contra a Seca (DNOCS), and subsequently spread throughout the whole country (Castagnolli 1996). It is classified as a pest and its introduction has a well known negative impact to the aquatic ecosystems (Froese & Pauly 2010).

Two migratory species were recorded, *Brycon orbignyanus* (piracanjuba) and *Leporinus friderici* (piauí-três-pintas), both represented by few individuals. Migratory species in the adult stage are mostly residents of larger streams or rivers, being occasionally found in these low-order streams when in their young stage (Pompeu & Godinho 2003). *Brycon orbignyanus* is considered endangered in Minas Gerais state, according to the IUCN Red Data List (Machado et al 2005; Alves et al 2007), due to habitat degradation especially driven by clearance of the riparian vegetation, pollution and construction of hydropower plants (Santos 2010).

This study fills part of the knowledge gap about fish from small streams of the Paraná basin by presenting the species list of regions unstudied until this moment. Inventories of the fish fauna from these low-order water courses are important because they highlight their biodiversity relevance, including a significant number of new species. As such, our findings can help inform future conservation and/or management strategies in the studied landscape.

Acknowledgments

The present study is part of the project: “Desenvolvimento de índices de integridade biótica (IBI em inglês) como ferramenta para avaliar a qualidade ambiental e subsidiar a restauração de habitats em áreas de soltura de alevinos pela CEMIG”. We thank our colleagues at the Laboratório de Ecologia de Peixes (UFLA) and Laboratório de Ecologia de Bentos (UFMG) for their help with the field work, Cláudio

Zawadzki, Guilherme Dutra, Naércio Menezes, Roberto Reis and Wolmar Wosiacki for helping with the species identification, the landowners for providing permission to conduct research on their properties, IBAMA for the collecting license (10327-1). We also thank Companhia Energética de Minas Gerais (CEMIG), Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, CRA 03147/11), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, CGL received scholarship: BEX2943/13-1) and P&D ANEEL/CEMIG GT 487 for financial support including the authors scholarships; FAPESP and CNPq for financial support to the studies of the ichthyofauna from the Upper Paraná and the modernization of the fish collection at DZSJRP (FL). PSP received a research fellowship from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq No. 306325/2011-0) and from the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG No. PPM-00237/13).

References

- AGOSTINHO, A.A., GOMES, L.C., SUZUKI, H.I., JULIO, Jr., H.F. 2003. Migratory fishes of the Upper Paraná river basin, Brazil. In CROSFELD, J., HARVEY, B., ROSS, C., BAER, A. Migratory Fishes of South America Victoria: world Fisheries Trust, p. 20-98.
- AGOSTINHO, A.A., GOMES, L.C., PELICICE, F.M. 2007. Ecologia e manejo de recursos pesqueiros em reservatórios do Brasil. Maringá: Eduem, 501 p.
- ALVES, C.B.M., VIEIRA, F., MAGALHÃES, A.L.B., BRITO, M.F. G. 2007. Impacts of non-native fish species in Minas Gerais, Brazil: presente situation and prospects. In BERT, M.T. Ecological and genetic implications of aquaculture activities, Dordrecht: Springer, p. 291-314.
- ARAUJO, F.G., PEIXOTO, M.G., PINTO, B.C.T., TEIXEIRA, T.P. 2009. Distribution of guppies *Poecilia reticulata* (Peters, 1860) and *Phallocheros caudimaculatus* (Hensel, 1868) along a polluted stretch of the Paranaíba do Sul River, Brazil. Braz. J. Biol. 69(1): 41-48.
- ARAUJO, J.R.S. 1983. Projeto de biodeteção de tóxicos em sistemas fluviais de utilização em captação de água para sistemas públicos de abastecimento. Cadernos FEEMA, Série Congressos 17(83): 1-129.
- BACARRO, C.A., MEDEIROS, S.M., FERREIRA, I.L., RODRIGUES, S.C. 2004. Mapeamento Geomorfológico da Bacia do Rio Araguari (MG). LIMA, S.C. & SANTOS, R.J. (Org.). In: Gestão Ambiental da Bacia do Rio Araguari - rumo ao desenvolvimento sustentável. Uberlândia: CNPq, p. 1-20.
- BERTACO, V.A. & LUCENA, C.A.S. 2006. Two new species of *Astyanax* (Ostariophysi: Characiformes: Characidae) from eastern Brazil, with a synopsis of the *Astyanax scabripinnis* species complex. Neotropical Ichthyology, 4(1):53-60.
- BISAZZA, A., MANFREDI, S., PILASTRO, A. 2000. Sexual competition, coercive mating and mate assessment in the one-sided livebearer, *Jenynsia multidentata*: are they predictive of sexual dimorphism? Ethology, 106(11):961-978.
- BONETTO, A.A. 1986. The Paraná river system. In: DAVIES, B.R., WALKER, K.F. The ecology of river systems. Dordrecht: Dr. W. Junk Publishers, p. 541-555.
- CARVALHO, E.D. 2006. Avaliação dos impactos da piscicultura em tanques-rede nas represas dos grandes tributários do alto Paraná (Tietê e Paranapanema): o pescado, a ictiofauna agregada e as condições limnológicas. Relatório Científico (FAPESP). Botucatu, SP. 46p.
- CASTAGNOLLI, N. 1996. Aquicultura para o ano 2000. Brasília: CNPq, 95p.
- CASTRO, R.M.C. & CASATTI, L. 1997. The fish fauna from a small forest stream of the upper Paraná River basin, Southeastern

- Brasil. Ichthyological Exploration Freshwaters, Cornol, 7(4): 337-352.
- CASTRO, R.M.C., CASATTI, L., SANTOS, H.F., FERREIRA, K.M., RIBEIRO, A.C., BENINE, R.C., DARDIS, G.Z.P., MELO, A.L.A., ABREU, T.X., BOCKMANN, F.A., CARVALHO, M., GIBRAN, F.Z., LIMA, F.C.T. 2003. Estrutura e composição da ictiofauna de riachos do Rio Paranapanema, sudeste e sul do Brasil. *Biota Neotropica* 3(1): <http://www.biotaneotropica.org.br/v3n1/pt/abstract?article+BN01703012003>.
- CASTRO, R.M.C., CASATTI, L., SANTOS, H.F., MELO, A.L.A., MARTINS, L.S.F., FERREIRA, K.M., GIBRAN, F.Z., BENINE, R.C., CARVALHO, M., RIBEIRO, A.C., ABREU, T.X., BOCKMANN, F.A., DARDIS, G.Z.P., STOPIGLIA, R., LANGEANI, F. 2004. Estrutura e composição da ictiofauna de riachos da bacia do Rio Grande, no Estado de São Paulo, Sudeste do Brasil. *Biota Neotropica* 4(1): <http://www.biotaneotropica.org.br/v4n1/pt/abstract?article+BN0170402004>.
- CENEVIVA-BASTOS, M. & CASATTI, L. 2007. Oportunismo alimentar de *Knodus moenkhausii* (Teleostei, Characidae): uma espécie abundante em riachos do noroeste do Estado de São Paulo, Brasil. *Iheringia. Série Zoologia*, 97:7-15.
- ESCHMEYER, W.N. & FONG, J.D. 2010. Species of Fishes by family/subfamily. Disponível em: <http://research.calacademy.org/research/ichthyology/catalog/speciesbyfamily>. Asp. Acesso em fev.
- FROESE, R. & PAULY, D. 2009. FishBase. World Wide Web electronic publication. <http://www.fishbase.org/home.htm>. Acesso em fev.
- FROESE, R. & PAULY, D. 2010. FishBase. World Wide Web electronic publication. <http://www.fishbase.org/home.htm>. Acesso em.
- GRAÇA, W.J. & PAVANELLI, C.S. 2007. Peixes da planície de inundação do alto rio Paraná e áreas adjacentes. Maringá. EDUEM. 241 p.
- GODINHO, A.L. & POMPEU, P.S. 2003. A importância dos ribeirões para os peixes de piracema. In: GODINHO, H.P., GODINHO, A.L. (Org.) Águas, peixes e pescadores do São Francisco da Minas Gerais. Belo Horizonte: PUC Minas, p. 361-372.
- IUCN Summary statistics 2008 Red list. Disponível em http://www.iucn.org/about/work/programmes/species/red_list/2008_red_list_summary_statisticsQindex.cfm. Acesso em nov.2008.
- KAUFMANN, P.R., LEVINE, P., ROBISON, E.G., SEELIGER, C., PECK, D.V. 1999. Quantifying Physical Habitat in Wadeable Streams. Washington, D. C.: EPA/620/R-99/003, U.S. Biodiversity Environmental Protection Agency, 102 p.
- KAVALCO, K.F. & PAZZA R. 2007. Aspectos biogeográficos de componentes da ictiofauna da América Central. *ConScientia e Saúde* 6(1):147-153.
- LANGEANI, F., CASTRO, R.M.C., OYAKAWA, O.T., SHIBATTA, O.A., PAVANELLI, C.S., CASATTI, L. 2007. Diversidade da ictiofauna do alto Rio Paraná: composição atual e perspectivas futuras. *Biota Neotropica*, Campinas, 5(1):75-78.
- LATRUBESSE, E., STEVAUX, J.C., SINHA, R. 2005. Tropical rivers. *Geomorphology* 70:187–206.
- LOWE-McCONNELL, R.H. 1987. Ecological studies in tropical fish communities. Cambridge: Cambridge Univ. Press, 382 p.
- MACHADO, A.B.M., MARTINS, C.S., DRUMMOND, G.M. 2005. Lista da fauna brasileira ameaçada de extinção: incluindo as espécies quase ameaçadas e deficientes em dados. Belo Horizonte: Fundação Biodiversitas.
- PAVANELLI, C.S. & CARAMASCHI, E.P. 1997. Composition of the ictiofauna of two small tributaries of the Paraná river, Porto Rico, Paraná State, Brazil. *Ichthyological Exploration of Freshwaters, München*, 8(1):23-31.
- REIS, R.E., KULLANDER, S.O., FERRARIS, C.J. 2003. Check List of the Freshwater Fishes of South and Central America. Porto Alegre: EDIPUCRS. 729 p.
- SANTOS, G.B. 2010. A ictiofauna da bacia do alto Paraná (rio Grande e rio Paranaíba). *MG Biota*, 2(6).
- SHIBATTA, A.O., GEALH, A.M., BENNEMANN, S.T. 2007. Ictiofauna dos trechos alto e médio da bacia do rio Tibagi, Paraná, Brasil. *Biota Neotropica*, Campinas, 7(2):125-134.

Received 08/12/2014

Revised 05/03/2015

Accepted 16/03/2015