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LISTS OF SPECIES

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Ichthyofauna of tributaries of the Vermelho River, upper Paraguay River basin, region of Rondonópolis, state of Mato Grosso, Brazil

Patrícia Cristina Vizzotto and **Reinaldo José de Castro***

Universidade Federal de Mato Grosso, Campus Universitário de Rondonópolis, Instituto de Ciências Exatas e Naturais, Departamento de Biologia, Rodovia MT 270, km 6, CEP 78735-901, Rondonópolis, MT, Brazil

* Corresponding author. E-mail: reinaldocastro@ufmt.br

Abstract: With the aim of finding information on the composition of the ichthyofauna of streams belonging to the Upper Paraguay River basin, in the municipality of Rondonópolis, state of Mato Grosso (MT), Brazil, we present a list of species captured at eight localities from October 2010 to April 2012. Fish were captured with sieves for approximately one hour at each site and date. We list 39 species from four orders, 15 families and 32 genera. Characiformes was represented by 19 species, Siluriformes by 15 species, Gymnotiformes by three species and Perciformes by two species.

Key words: inventory, fauna of fishes, Mid-west Brazil, stream

INTRODUCTION

The Neotropical region is the richest in number of fish species, with estimates reaching up to 8,000 in fresh water habitats alone (Schaefer, 1998). The headwaters of the major river basins of South America are located in Mato Grosso, where the Cerrado, Pantanal and Amazon Rainforest domains are closely associated and dependent on these macro-basins and micro-drainage systems, housing a complex ichthyofauna from a taxonomic point of view.

However, recent decades have seen the disappearance of several fish species, mainly due to impact generated by human action. Currently, the Cerrado is one of the most threatened ecosystems in the world, due to human occupation. The major threats to biodiversity are related to two economic activities: intensive grain monoculture and low tech extensive ranching. Historically, agricultural expansion has been characterized by a predatory model. Techniques of intensive land use employed for many years have exhausted the local resources.

The indiscriminate use of pesticides and fertilizers has contaminated soil and water. In recent years, the accelerated construction of SHPs (Small Hydro Power Plants) in the state of Mato Grosso, also emerges as a possible threat to biodiversity, causing alteration to the regime of water flow, silting of rivers, and removal of native vegetation, among other problems.

Fish represent the most diverse group among the vertebrates and one of the most interesting (Nelson 2006). This significant diversity has attracted growing interest in the pursuit of basic information. Thus, in recent decades, groups focusing on the study of fish have increased greatly. Current inventories, studies in systematics, ecology, reproduction, cytogenetics, molecular biology, among others, have been published (Reis et al. 2003; Lowe-McConnell, 1999; Oliveira et al. 2009; among others). However, such studies have focused more on southern and southeastern Brazil, where the largest number of researchers is concentrated. In the central-west region, the Pantanal biome has aroused greater interest and, consequently, there is a slightly higher number of articles from this area.

The Pantanal is a vast sedimentary plain located in the central-west region of Brazil (Britski et al. 2007). In this floodplain, the tributaries of the Paraguay River, which drain the system, are environments that vary seasonally, determining changes in food and movement of fish that occupy the lower parts of the plain. The source of the Vermelho River is in the municipality of Poxoréu (state of Mato Grosso) and is the main tributary of the left bank of the São Lourenço River which, in turn, empties into the northeastern edge of the Pantanal. The Vermelho River and its tributaries drain the municipality of Rondonópolis (state of Mato Grosso), and other municipalities in the region. Similar to other rivers in the region, this river has recently suffered from constant removal of riparian vegetation, causing siltation and gradual decrease in the flow of its waters.

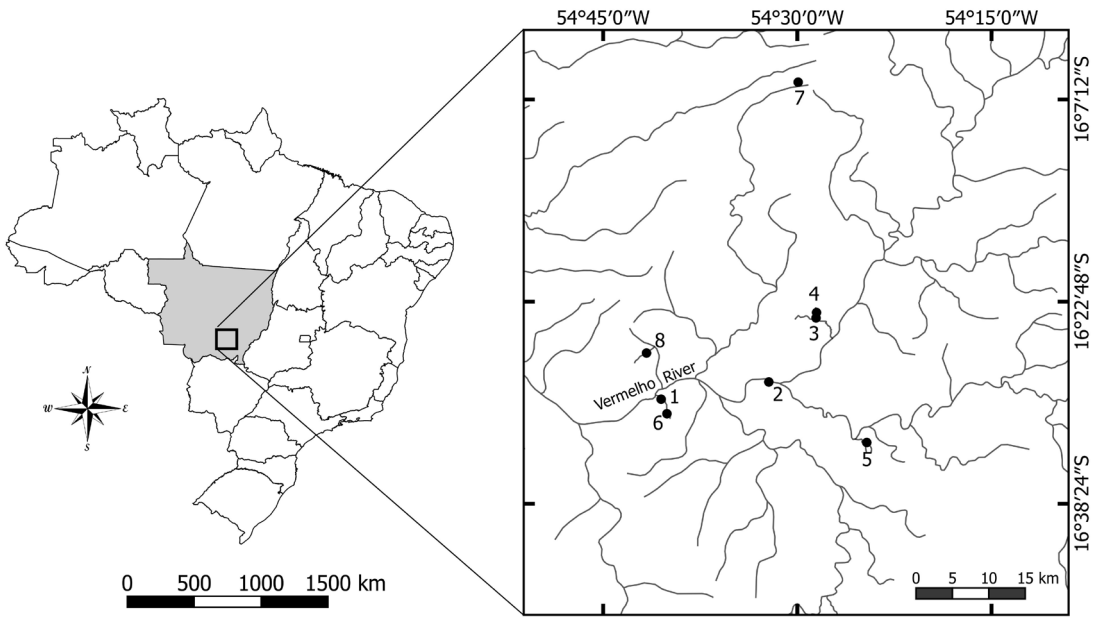

Figure 1. Study area in the tributaries of Vermelho River. Sampling stations: (1) Esparramo Stream, (2) Pitaluga Stream, (3) Três Pontes Stream (Bridge 1), (4) Três Pontes Stream (Bridge 2), (5) Source of Tadarimana River, (6) Azul Lagoon, (7) source of Arareal River and (8) Escondidinho Stream.

Among Neotropical fish, the orders Characiformes and Siluriformes are the most dominant (Britski 1972). This author emphasizes that the family Characidae is the most representative of freshwater fish in Brazil. For the Pantanal, Britski et al. (2007) list 269 species of fish, distributed in 36 families. In this case, Characiformes is the dominant order, with 110 species, followed by Siluriformes with 105 species. However, the ichthyofauna of the Vermelho River and the streams that form it, is little known. Castro and Vizzotto (2013) reported a marked predominance of Characiformes, in relation to the number of species and individuals (60.53%), over Siluriformes (28.95%) in the Vermelho River. Thus, the main objective of this study is to present information on the ichthyofauna of some of these streams.

MATERIALS AND METHODS

The collection of fish was carried out at eight sites belonging to the drainage basin of the Upper Paraguay River, in the municipality of Rondonópolis, MT, Brazil, from October 2010 to April 2012. Fish were captured with 5 mm mesh sieves for about one hour at each site and date. Fishes were collected under ICMBio (Instituto Chico Mendes de Conservação da Biodiversidade) permits (21546-1/2009). The points were georeferenced and the geographical coordinates obtained are shown in Table 1 and Figure 1.

After capture, the animals were fixed in 10% formalin, where they remained for 48 hours. They were then preserved in 70% ethanol and identified to the lowest taxonomic level possible. The identification was carried out first by using the identification keys of Britski et al. (2007) and, subsequently, confirmed by experts. Voucher specimens of each species are deposited in the fish collection of the Laboratory of Ichthyology of the Universidade Federal de Mato Grosso, Campus Rondonópolis and in the Ichthyologycal Collection of Nupélia (Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura) of the Universidade Estadual de Maringá (UEM).

RESULTS

A total of 463 fish specimens were captured, distributed among four orders, 15 families, 32 genera and 39 species. The family Characiformes was represented by

Table 1. Geographical coordinates and collection sites of the fish.

Collection Site	Geographic coordinates	No. of collections
Esparramo Stream	16°30'19.56" S, 054°40'31.56" W	5
Pitaluga Stream	16°28'38.10" S, 054°32'8.28" W	3
Três Pontes Stream (Bridge 1)	16°23'59.46" S, 054°28'33.48" W	1
Três Pontes Stream (Bridge 2)	16°23'53.22" S, 054°28'29.94" W	1
Source of Tadarimana River	16°33'40.20" S, 054°24'38.58" W	1
Azul Lagoon	16°31'26.94" S, 054°40'4.76" W	1
Source of Arareal River	16°05'51.66" S, 054°29'56.52" W	1
Escondidinho Stream	16°26'27.20" S, 054°41'00.70" W	1

19 species (48.72%), Siluriformes by 15 species (38.46%), Gymnotiformes by three species (7.69%) and Perciformes by two species, corresponding to 5.13% (Table 2).

The most frequent species, which represented 20.95% of the total specimens captured, was *Astyanax lineatus* (Perugia, 1891), followed by *Jupiaba acanthogaster* (Eigenmann, 1911), *Hypostomus cochliodon* Kner, 1854 and *Characidium* aff. *zebra* Eigenmann, 1909, which accounted for 11.66%, 10.80%, and 10.15% of the total, respectively.

Characidium aff. *zebra* Eigenmann, 1909, was the most

Table 2. List of fish species captured in the tributaries of Vermelho River, Rondonópolis, MT, Brazil, with their respective voucher numbers.

Order/family/sub-family	Species	Collection sites								Total
		1	2	3	4	5	6	7	8	
CHARACIFORMES										
Characidae										
Aphyocharacinae	*Aphyocharax anisitsi* Eigenmann & Kennedy, 1903 NUP. 12217		3							3
	Prionobrama paraguayensis (Eigenmann, 1914) MZCUR/UFMT 53		1							1
Cheirodontinae	*Odontostilbe calliura* (Boulenger, 1900) MZCUR/UFMT 90		2							2
	Odontostilbe pequira (Steindachner, 1882) NUP. 12223		27							27
	Odontostilbe sp. NUP. 12213			3					2	5
	Serrapinnus microdon (Eigenmann, 1915) MZCUR/UFMT 42					3				3
Incertae sedis	*Astyanax asuncionensis* Géry, 1972 NUP. 12234	17	10					2		29
	Astyanax lineatus (Perugia, 1891) NUP. 12232	112				9		1		122
	Astyanax marionae Eigenmann, 1911 MZCUR/UFMT 18	15								15
	Bryconamericus exodon (Eigenmann, 1907) MZCUR/UFMT 70		1							1
	Jupiaba acanthogaster (Eigenmann, 1911) MZCUR/UFMT 17	33	1			7		3	10	54
	Knodus chapadae (Fowler, 1906) NUP. 12228		9					1		10
	Moenkhausia oligolepis (Günther, 1864) NUP. 12229		3							3
Stethaprioninae	*Gymnocorymbus ternetzi* (Boulenger, 1895) MZCUR/UFMT 23		7							7
Crenuchidae										
Characinae	*Characidium* aff. *zebra* Eigenmann, 1909 MZCUR/UFMT 04	23	12	2			1	3	6	47
Erythrinidae	*Hoplias malabaricus* (Bloch, 1794) MZCUR/UFMT 24		2				2		1	5
Lebiasinidae	*Pyrrhulina australis* Eigenmann & Kennedy, 1903 MZCUR/UFMT 46						16			16
Parodontidae	*Apareiodon* sp. NUP. 12215		2							2
	Parodon nasus Kner, 1859 MZCUR/UFMT 96							1		1
GYMNOTIFORMES										
Gymnotidae	*Gymnotus inaequilabiatus* (Valenciennes, 1839) MZCUR/UFMT 79		2			1			1	4
Hypopomidae	*Brachyhypopomus* sp.C MZCUR/UFMT 56		1							1
Sternopygidae	*Eigenmannia trilineata* López & Castelo, 1966 MZCUR/UFMT 59		16							16
PERCIFORMES										
Cichlidae	*Cichlasoma dimerus* (Heckel, 1840) NUP. 12237		3						2	5
	Crenicichla lepidota (Heckel, 1840) MZCUR/UFMT 77		1						3	4
SILURIFORMES										
Auchenipteridae	*Parauchenipterus* sp. MZCUR/UFMT 107								1	1
Callichthyidae	*Corydoras aeneus* (Cill, 1858) NUP. 12238		13							13
	Hoplosternum littorale (Hancock, 1828) MZCUR/UFMT 40					2				2
Heptapteridae	*Imparfinis* sp. NUP. 12226		1							1
Loricariidae										
Ancistrinae	*Ancistrus cuiabae* Knaack (1999) MZCUR/UFMT 51		1							1
	Ancistrus sp. MZCUR/UFMT 89		6							6
Hypoptopomatinae	*Otocinclus vitattus* Regan, 1904 MZCUR/UFMT 66		6		8	9				23
Hypostominae	*Hypostomus* cf. *latirostris* (Regan, 1904) MZCUR/UFMT 63		1							1
	Hypostomus cochliodon Kner, 1854 MZCUR/UFMT 05	21	29							50
	Hypostomus sp. MZCUR/UFMT 06	10	1	2					3	16
Loricariinae	*Farlowella paraguayensis* Retzer & Page, 1997 NUP. 12221		2							2
	Rineloricaria aurata (Knaack, 2003) – NUP. 12211		1	4	4					9
Pimelodidae	*Pimelodella mucosa* Eigenmann & Ward, 1907 MZCUR/UFMT 27		1							1
	Rhamdia quellen (Quoy & Gaimard, 1824) MZCUR/UFMT 31	1	5	4						10
Trichomycteridae	*Ituglanis eichorniarium* (Ribeiro, 1912) MZCUR/UFMT 69		4							4

1. Esparramo S., 2. Pitaluga S., 3. Três Pontes S. (Bridge 1), 4. Três Pontes S. (Bridge 2), 5. Source Tadarimana R., 6. Azul Lagoon, 7. Source Arareal R. and 8. Escondidinho S.

frequent species in the sampling sites, being captured at all localities, except at Três Pontes Stream (Bridge 2) and at the source of Tadarimana River. *Jupiaba acanthogaster* (Eigenmann, 1911), was also found with frequency in the collection sites, with the exception of the Três Pontes Stream (Bridges 1 and 2) and the Azul Lagoon.

DISCUSSION

The results obtained in this study, in which 39 species were recorded, are very modest when considering the diversity presented in studies by Britski et al. (2007), who recorded 269 species of fish for the Pantanal. However, these results do reveal the richness of the fish fauna of the region. According to Castro (1999), the fish fauna of continental freshwater in the world, both in terms of taxonomic diversity and biomass, is dominated by Ostariophysi, namely by the orders Characiformes and Siluriformes. The absolute dominance of species of Characiformes and Siluriformes orders, verified in our study, reflects that expected for the tropical region (Lowe-McConnell 1999). This predominance may be associated with environmental structure which provides adequate conditions for species of these orders.

The ichthyofauna captured in this study was composed of small-sized species, up to 20 cm long, commonly found in small streams, as observed by Lowe-McConnell, 1999. Caramaschi (1986), studying tributary streams of the Paranapanema River, determined that the distribution of species in these environments is directly linked to environmental factors such as river size and availability of shelter. For Castro and Menezes (1998) species with no commercial value that inhabit these environments have a high degree of endemism and are directly dependent on riparian vegetation for food, reproduction and shelter and should be widely studied.

Castro and Vizzotto (2013) listed 38 species of fish for the coastal region of the Vermelho River. The ichthyofauna was composed of small species and juveniles of medium and large species. Of the species found by the authors, only eleven were also represented in our results. Thus, our list of species expands the list reported in Castro and Vizzotto (2013) by 27 new species, increasing significantly the number of species caught in the Vermelho River basin. The order Siluriformes increased by 13 new species, Characiformes by ten, Gymnotiformes by three and Perciformes by two.

The inventory of fish conducted by Oliveira et al. (2015) in urban tributaries of the Vermelho River also confirmed the predominance in number of species of Characiformes (29) and Siluriformes (16), followed by representatives of Gymnotiformes (6), Perciformes (4) and Cyprinodontiformes (1). However, it should be emphasized that the methodologies used for the capture of fish in our study were different to those applied by Castro and Vizzotto (2013) and Oliveira et al. (2015). For Silveira et al. (2010), the use of a single sampling method is impossible to be applied in all freshwater habitats, since the water courses are very heterogeneous. In fact, when properly applied, a greater number of species are collected when different methodologies are used, helping to ensure that aquatic micro-habitats are adequately sampled (Silveira op. cit.). According to Mattox and Iglesias (2010), an approach using different fishing gear and the use of species accumulation curves seems to be useful to define whether the collection effort in certain areas was sufficient. The different methodologies for fish capture used in our study and in the studies of Castro and Vizzotto (2013) and Oliveira et al. (2015) served to maximize the number of species listed for the basin.

In the studied environments, the species with wide distribution were *J. acanthogaster* and *C.* aff. *zebra*. These species occurred in sample sites five and six, respectively. For Agostinho and Júlio Jr. (1999) and Lowe-McConnell (1999), small streams house a fauna composed of small-sized representatives of the order Characiformes, and usually inhabit aquatic environments with different levels of environmental quality.

Neotropical streams show a predominance of the family Characidae, mainly represented by *Astyanax, Hyphessobrycon* and *Bryconamericus*, among others (Mehanna and Penha, 2011). The occurrence observed for the species *A. lineatus*, especially in Esparramo stream, indicates its preference for environments with strong rapids. Mehanna and Penha (2011) reported that this species, among other congeners, does not have a specific selectivity for environmental variables such as pH, electrical conductivity and turbidity of water in the environments they studied, and its distribution is therefore not affected by water quality.

The environmental degradation of streams caused by the inappropriate use of banks for the development of agricultural and livestock activities was verified throughout the study period. These activities produced, and continue to produce, huge impact on water bodies, leading to sharp changes in riparian zones. As shown by Sala et al. (2000), changes in riparian zones can lead to increased input of nutrients, sediments and contaminants, significantly impacting the communities who live there. As a result of these factors, Dudgeon et al. (2006) and Felipe and Súarez (2010) reported that the significant drop in water quality leads to loss of aquatic biodiversity due to the disintegration of the physical and chemical environment and changes in the natural dynamics of biological communities. Therefore, it is urgent to study the taxonomic and systematic composition as well as the ecological parameters of the streams that house this unknown ichthyofauna (Castro 1999).

There is an urgent need for broader studies, focusing on the identification of the species that populate the rivers of the region that have been rapidly deteriorating,

and on the importance of these species in the composition of ecosystems. More detailed studies, from a taxonomic, ecological, and reproductive point of view, among others, are also necessary.

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