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Ichthyofauna of the hydrographic basin of the Chasqueiro Stream (Mirim Lagoon system, southern Brazil): generating subsidies for conservation and management

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Abstract: Studies that organize lists of species are essential and act as the starting point for future discussions on the ecology of fish in environments that are poorly studied. The present paper describes the fish assemblage of the hydrographic basin of Chasqueiro Stream, an important component of the Mirim Lagoon system. Fish were collected during one year period between August/2012 and July/2013 in six sites, comprising three biotopes: upstream, reservoir and downstream. A total of 22,853 specimens were collected, and were distributed into 83 species, 20 families, and eight orders. The two species with the largest number of individuals captured were *Bryconamericus iheringii* with 2,904 (12.71%) and *Cheirodon ibicuiensis* with 2,868 (12.55%). Characiformes and Siluriformes were the most representative orders in terms of richness and abundance. *Bryconamericus iheringi* and *Cyanocharax alburnus* were the species with the highest abundance upstream, while *Hyphessobrycon luetkenii* and *Corydoras paleatus* contributed more to the abundance downstream. *Cheirodon ibicuhiensis* and *Heterocheirodon jacuhiensis* were the most representative species in the reservoir. This study revealed a rich fauna of fish, which should be preserved for future generations and for the maintenance of local and regional biodiversity.
Keywords: *Neotropical region, costal plain, Patos-Mirim Lagoon system.*

CORRÊA. F., OLIVEIRA, E.F., TUCHTENHAGEN, T., POUEY, J., PIEDRAS, S. **Ictiofauna da bacia hidrográfica do arroio Chasqueiro (sistema da Lagoa Mirim, sul do Brasil): gerando subsídios para plano de conservação e gestão.** Biota Neotropica. 15(4): e0006. http://dx.doi.org/10.1590/1676-0611-BN-2015-0006

Resumo: Estudos que organizam listas de espécies são essenciais como ponto de partida para futuros debates sobre a ecologia de peixes em ambientes que são pouco estudados. O presente artigo descreve a fauna de bacia hidrográfica do arroio Chasqueiro, componente importante do sistema da Lagoa Mirim. Os peixes foram coletados no período de um ano, entre os meses de agosto de 2012 e julho de 2013, em seis locais amostrais, que compreendem três biótopos, montante, reservatório e jusante. Um total de 22.853 indivíduos foi coletado, distribuídos em 83 espécies, 20 famílias e oito ordens. As duas espécies com maior abundância foram *Bryconamericus iheringii* com 2.904 (12,71%) e *Cheirodon ibicuiensis* com 2.868 (12,55%). Characiformes e Siluriformes foram as ordens mais representativas em termos de riqueza e abundância. *Bryconamericus iheringii* e *Cyanocharax alburnus* foram as que apresentaram as maiores abundâncias a montante, *Hyphessobrycon luetkenii* e *Corydoras paleatus* contribuíram mais na abundância a jusante, enquanto no reservatório as mais abundantes foram *Cheirodon ibicuhiensis* e *Heterocheirodon jacuhiensis*. Este estudo revelou uma rica ictiofauna na bacia hidrográfica do arroio Chasqueiro, a qual deveria ser preservada para as gerações futuras e para a manutenção da biodiversidade local e regional.
Palavras-chave: *Região neotropical, planície costeira, Arroio Chasqueiro, sistema lagunar Patos-Mirim.*

Introduction

Having knowledge of the fish species that colonize a hydrographic basin is the first step in producing information about the structure of the local assemblage, as well as the trophic and reproductive dynamics. The Neotropical region has the highest diversity of freshwater fish species in the world, with estimates of up to approximately 8,000 species (Schaefer 1998, Lévêque et al. 2008, Albert & Reis 2011). López-Fernández et al. (2012) emphasize that knowledge of the fish fauna is of utmost importance, because it can reveal the relative role of adaptive processes, structural complexity, evolutionary history, and morphological and functional diversification. Indeed, studies that organize lists of species are essential and act as the starting point for future discussions on the ecology of fish in environments that are still poorly studied (Schifino et al. 2004, Vaske et al. 2005). Agostinho et al. (2008) stress that the diversity of fish in the continental ecosystems of Brazil is poorly known, and is greatly associated with the absence of an inventory in these environments. Carrying out studies that include lists of fish species in hydrographic basins is the initial and a fundamental step to the proper management and preservation of fish fauna (Raghavan et al. 2008, Santos et al. 2015). Information about species composition is the basis for recognizing the structure of the assemblage, as well as understanding its dynamics. The detection of these patterns allows the possibility of a more precise conservation plan for the area, defining the priorities in detail.

The fish fauna of freshwater ecosystems have suffered directly from the impacts associated with urban population growth (Pendleton et al. 2014). Other factors such as the introduction of exotic species (Vitule 2012), pollution and deforestation (Carvalho et al. 2012), busbaraquatic ecosystems (Burns et al. 2006, Barletta et al. 2010), and predatory fishing have contributed significantly to the decline in species richness. It is worth mentioning that the changes and loss of natural habitats have been directly influenced by human activities, which have led to loss of biodiversity (Teixeira et al. 2005, Schindler 2007, Barros et al. 2012). For example, Daga et al. (2012), studying the influence of human activity on the fish assemblage in a sub-basin of the San Francisco River, showed that along a longitudinal gradient there is a significant urbanization effect on the fish assemblage, primarily caused by urban organic effluents and urban activity runoff. An aspect that hinders understanding of the impacts of human activities on the fish community in a hydrographic basin is the lack of studies about local or regional species composition.

Among the countries that form the Neotropical region, Brazil has around 2,500 freshwater fish species in its hydrological systems (Reis et al. 2003, Buckup et al. 2007), which is related to the large diversity of aquatic systems present in its different biomes. In southern Brazil, transgression and regression events created the largest lagoon complex in South

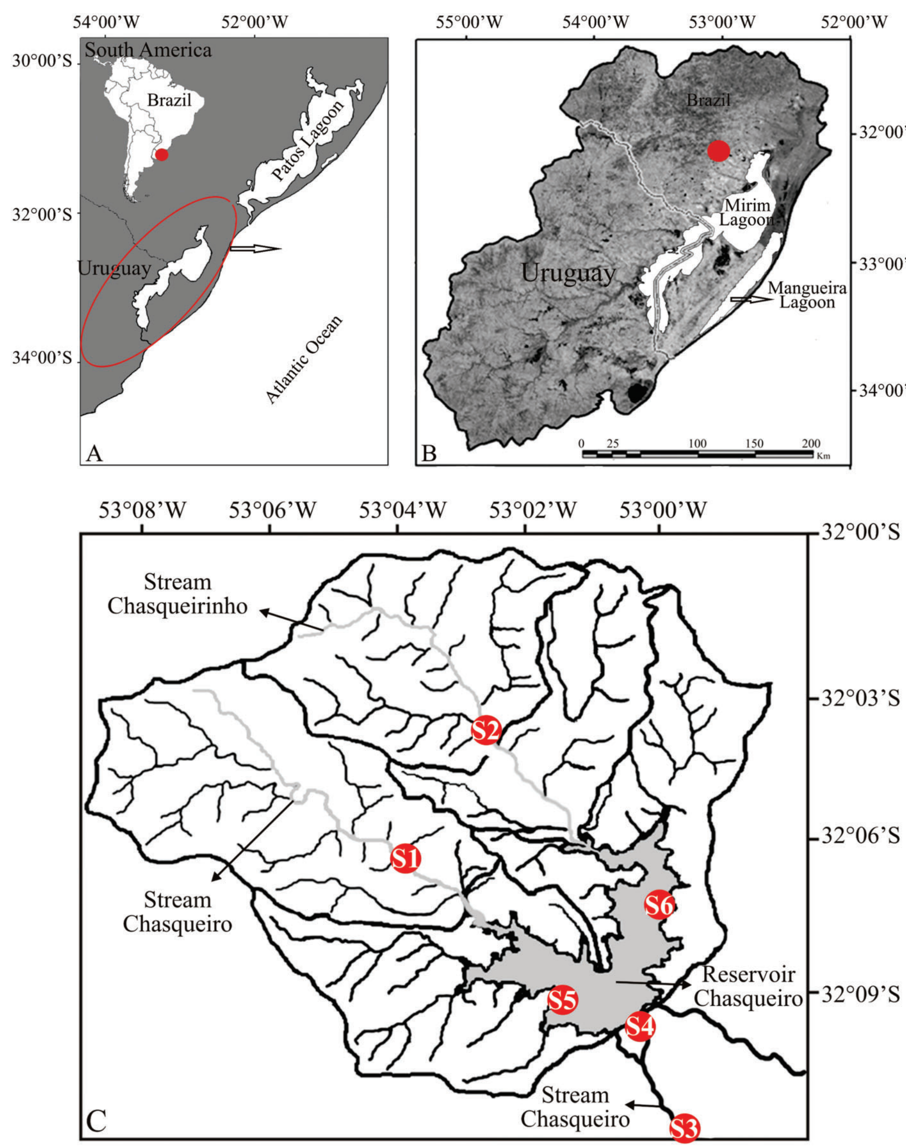

Figure 1. Study area, showing south America with the countries Brazil and Uruguay, delimitation of Mirim Lagoon system (circle red) (A), localization of hydrographic basin Chasqueiro Stream (dot red) (B) and samples sites, 1 and 2 (upstream), 3 and 4 (downstream), 5 and 6 (reservoir) (C).

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America, formed by the Patos and Mirim lagoons, which together comprise an area of about 14,000 km^2 (Villwock 1987, Kotzian & Marques 2004). It is worth mentioning that the communication between the Patos and Mirim lagoon systems occurs through a natural channel called São Gonçalo. In 1977, a dam was constructed to prevent the entry of salt water into the region of Mirim Lagoon, the main water source used for agriculture, particularly for rice cultivation (Burns et al. 2006, Corrêa et al. 2015). The hydrographic system of Mirim Lagoon is formed by a complex composed of 22 basins, distributed between Brazil and Uruguay (Kotzian & Marques 2004). However, there is still an absence of studies and knowledge of the fish fauna occurring in the sub-basins located in southern Brazil (Buckup & Reis 1997, Garcia et al. 2006, Ceni & Vieira 2013). In this context, the present study describes the fish assemblage of the hydrographic basin of Chasqueiro Stream, an integral part of the Mirim Lagoon system, with the goal of contributing to the advancement of knowledge on the composition of its ichthyofauna, as well as the production of information that can be used in action protocols aiming the system conservation.

Material and methods

The hydrographic basin of Chasqueiro Stream (BHAC) is located in the western region of the hydrographic system of Mirim Lagoon, municipality of Arroio Grande, southern Brazil (31°6'51"S/50°5'17"W) (Figure 1). The region has a subtropical climate (according to Köppen), with an average annual rainfall ranging from 1,200 to 1,450 mm, with monthly average temperatures of 25°C in the hottest months and 11°C during the coldest. The BHAC is formed by two principal streams (Chasqueiro and Chasqueirinho) and a reservoir. The area upstream from the reservoir is 248.42 km^2, and is formed by the Chasqueiro Stream (114.84 km^2) and the Chasqueirinho Stream (133.58 km^2) basins. Chasqueiro Reservoir has an area of 1,800 ha, and is used primarily for rice monoculture (Sondotécnica 1986). Six sampling points were established along the BHAC: upstream – sites 1 (Chasqueiro Stream) and 2 (Chasqueirinho Stream); downstream – sites 3 and 4 (Chasqueiro Stream); Chasqueiro Reservoir – sites 5 and 6 (Figure 1; Figure 2) and a description of the sampling sites is shown in Table 1. Fish were collected monthly for one year between August/2012 and July/2013 (SISBIO #n.34389-1), totaling 72 samples. Because of the diversity of habitats that were investigated, it was not possible to maintain a standardized effort for all points and became necessary to employ different collection apparatuses, assuming that the use of the set of fishing gear increased the sampling efficiency. The following apparatuses were used: a) gill net: 75 m long with 10 meshes; 20, 30, 40 and 50 mm (knot to knot) submerged for a period of 24h (checked after 12h); used in reservoir depths between 1.0 and 2.5 m in order to capture larger individuals (> 200 mm); b) beam trawl: 5 m long, 2.25 high, with 5 mm mesh (knot to knot) employed in the coastal zones of the reservoir and downstream, with five trawls at each site per collection; c) two dip nets: 5 mm mesh opening, 35 cm wide and 50 cm long, used upstream and downstream in areas with and without vegetation, and used for 30 minutes at sites with depths

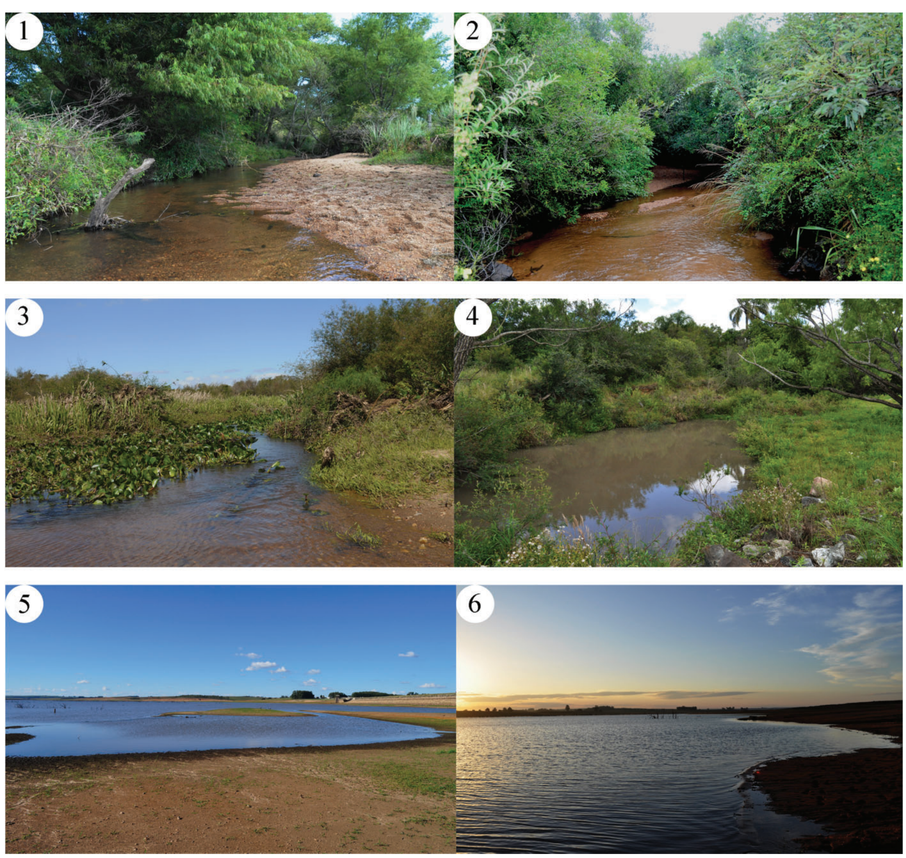

Figure 2. Photograph of the sampling sites 1 and 2 (upstream), 3 and 4 (downstream), 5 and 6 (reservoir) (C), hydrographic basin Chasqueiro Stream, Mirim Lagoon system, southern Brazil.

Table 1. Characterization of sampling sites, upstream, downstream and reservoir, presenting the biotopes, general characteristics, substrate and geographic coordinates, the sites located in the hydrographic basin of Chasqueiro Stream, Mirim Lagoon system, southern Brazil.

Sample sites	Biotopes	General characteristics	Substrate	Geographic coordinates
S1	Upstream	Margins formed by pastures. In some stretches, herbaceous individuals, shrub, and tree species are found; for example, *Eryngium* spp., *Baccharis* spp., and *Salixum boldtiana*, respectively. It features an average width of 7.9 m and an average depth of 29.1 cm. Features locations with little riffle and pool.	The substrate consists of 97.9% sand, 1.6% clay, and 12.5% silt. Presence of boulders derived from anthropogenic activities.	32° 07' 43.97"S 53° 03' 8.03"W
S2		Both margins contain arboreal vegetation. Presence of groups of rooted herbaceous species in stream bed. Shading occurs around 80% of the water. Left margin with siltation in the bed of course. Has an average width of 7.6 m and average depth of 43.8 cm. Present locations with little riffle and pool.	The substrate consists of 99.4% sand, 0.4% clay, and 0.2% silt. Occurrence of boulders derived from anthropogenic activities.	32° 06' 05.89"S 53° 03' 0.94"W
S3	Downstream	Presence of free and floating aquatic macrophytes such as *Eichhornia crassipes* and rooted *Polygonum punctatum*. Groups of shrubs and tree species on both sides of individuals such as *Calliandra brevipes*. Average width of 6.2 m and average depth of 31.9 cm. Presents with a flow site and with a predominance of local shallows.	Substrate consisting of 90.67% sand, 10.08% clay, and 23.1% silt.	32° 12' 11.08"S 52° 58' 9.70"W
S4		On both sides graminóide is the predominant vegetation. Posterior part of the left bank reveals an arboreal stratum. Presence of floating aquatic macrophytes. It features shadowing of the water depth around 50%. Has an average width of 5.0 m and average depth of 66.7 cm. Environment essentially shallows.	Predominantly sand with 90.5%, followed by silt and clay with 5.5% and 3.9%.	32° 09' 55.73"S 53° 00' 9.46"W
S5	Reservoir	Margins are predominantly anthropogenic fields of grasses used for grazing.	The site has a substrate with a predominance of 73.60% sand, followed by clay and silt with 14.0% and 12.4%. Local occurrence of boulders.	32° 10' 05.09"S 53° 01' 6.53"W
S6		It features anthropogenic fields consisting of grasses used for grazing on the shores.	A predominance of sand substrate with 73.5%, followed by clay and silt with 14.0% and 12.2%. Locations with muddy bottoms are present.	32° 08' 59.69"S 53° 00' 1.16"W

of 10 cm to one meter and d) one sieve with 5 mm mesh, 80 cm wide and 160 cm long, employed upstream and downstream, and used for 15 minutes per month at each site.

The collected fish were stored in plastic bags, labeled, and fixed in 10% formalin, and were then taken to the laboratory where they were transferred to 70% alcohol. Specimens were identified with the help of specialized literature (Reis & Malabarba 1988, Buckup & Reis 1997, Rodriguez & Reis 2008, Caravalho & Reis 2009, Bertaco & Lucena 2010, Carvalho et al. 2012, Lucena et al. 2013, Malabarba et al. 2013), and specialists were consulted when needed for species confirmation. The list of species was formulated according to Wiley & Johnson (2010) and Malabarba et al. (2013). The specimen testimonies were deposited in the ichthyological collection of the Federal University of Rio Grande (FURG). The number of species was estimated for each sampling site, and the Shannon-Wiener diversity index (H') and Pielou's evenness index were also used for calculations with PAST 3.0 statistical software (*PAlaeontological STatistics*, Hammer et al. 2014).

Results and Discussion

A total of 22,853 individuals were collected. They were represented by 83 species, 20 families, and eight orders (Table 2). The two species with the greatest number of individuals captured were *Bryconamericus iheringii* (2,904; 12.71%) and *Cheirodon ibicuiensis* (2,868; 12.55%). When the data of the orders were compared among different biotopes (upstream, downstream, and

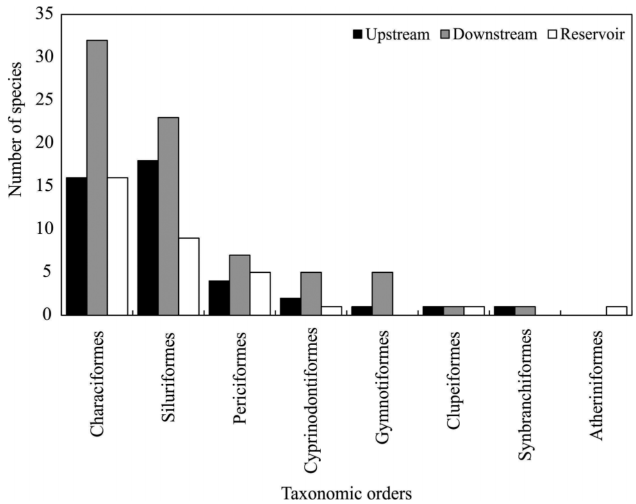

Figure 3. Number of fish species by taxonomic order, for the three biotopes (upstream, downstream and reservoir) of hydrographic basin Chasqueiro Stream, Mirim Lagoon system, southern Brazil.

reservoir), Characiformes and Siluriformes were the most representative in terms of abundance and richness (Table 2; Figure 3). Artioli et al. (2009), studying dominance patterns of an aquatic ecosystem in southern Brazil, also recorded high abundance of Characiformes species (e.g. *Bryconamericus iheringii*). Similarly, Becker et al. (2013) studied the fishes of the Taquari-Antas River basin and Garcia et al. (2006) compared the dominance patterns of the fish fauna of Taim wetlands. The predominance of species belonging to Characiformes and Siluriformes corroborates studies conducted in Neotropical aquatic ecosystems (Lowe-McConnell 1999, Becker et al. 2013, Viana et al. 2013). The high diversity, as well as the abundance of Characiformes and Siluriformes in the Neotropical region, is related to several factors, e.g. the ecological and behavioral patterns of the species (Carvalho et al. 2012), diversity of ecosystems (Oliveira et al. 2012), as well as evolutionary and geological processes (Lévêque et al. 2008). Teixeira et al. (2005) emphasize that the differences in physiography over a longitudinal gradient corresponded to the changes in the diversity and abundance of the fish assemblage, where species of Characiformes and Siluriformes have wide spatial distribution.

The rarest species in the system were *Trachelyopterus lucenai* and *Gymnotus pantherinus* (0.004%), which corroborate data reported by Artioli et al. (2009) in Mangueira Lagoon, Rio Grande do Sul state. *Trachelyopterus lucenai* is not considered a native species of the region, and might have come to the hydrographic basin through irrigation channels (rice fields) (Bertoletti et al. 1992, Becker et al. 2013).

Eleven species common to every collection site were identified among the upstream, downstream, and reservoir biotopes: six species of Characiformes (*Astyanax eigenmanniorum*, *Bryconamericus iheringii*, *Cheirodon ibicuhiensis*, *Cheirodon interruptus*, *Cyanocharax alburnus* and *Hyphessobrycon luetkenii*), three of Siluriformes (*Corydoras paleatus*, *Pimellodela australis* and *Homodiaetus anisitsi*), and two of Perciformes (*Gymnogeophagus gymnogenys* and *Crenicichla lepidota*). These species are illustrated in Figure 4.

The number of species collected represents a total of 51.87% of the 160 total species recorded for the Patos-Mirim Lagoon system (Becker et al. 2013). Studies to expand lists of fish species in the Mirim Lagoon system were conducted in the Taim Ecological Reserve (Buckup & Malabarba 1983, Grosser et al. 1994, Garcia et al. 2006), where 51 to 62 fish species were recorded. Based on analysis of the different sampling sites, the stretch that showed a larger number of individuals consisted of sites 3 (downstream) (5,665; 24.79%) and 5 (reservoir) (5,600; 25.5%). Note that downstream site 3 presents a large predominance of aquatic macrophytes that provide refuge from predators, which are important for feeding and reproduction (Lowe-McConnell 1999). However, at site 5, the high abundance may be associated with the high reproduction rate of the forage species (e.g. *Cheirodon ibicuiensis* and *Astyanax* aff. *fasciatus*). Agostinho et al. (1999) describe how the high abundance of forage species is associated with a high reproduction rate, as well as how feeding flexibility favors the colonization of these reservoir species.

The dominant species at site 3 was *Hyphessobrycon luetkenii* (1,454; 25.66%), while at site 5, *Cheirodon ibicuiensis* was the most representative species (1,414; 25.25%). In terms of number of species, sites 3 and 4 (downstream) showed higher values of species richness (67; 80.72%) and (53; 63.85%), respectively. However, site 6 was less diverse (28; 33.73%) (Table 2). *Bryconamericus iheringii* and *Cyanocharax alburnus* were the species with the highest abundance upstream. *Hyphessobrycon luetkenii* and *Corydoras paleatus* contributed more to the abundance downstream. The most representative species in the reservoir were *Cheirodon ibicuhiensis* and *Heterocheirodon jacuhiensis*.

Regarding ecological indices, the upstream Shannon diversity index values were 2.57 and 2.22 at sites 1 and 2, respectively. However, the downstream Shannon diversity index values at sites 3 and 4 were greater (3.00 and 2.83, respectively), while the reservoir was the least diverse biotope (2.04 and 2.09) (Table 2). The same pattern can be observed in relation to the evenness index of Pielou, as the downstream sites demonstrated the highest values (0.75 and 0.72), while the reservoir presented the lowest equitability values (0.30 to 0.63) (Table 2). At the six BHAC sampling sites, two species expanded their spatial distribution: *Acestrorhynchus pantaneiro*, an invasive species in the Patos-Mirim Lagoon system (Einhardt et al. 2014) and *Cyphocharax spilotus*, which was recorded in the northern part of this system and in the BHAC (Corrêa et al. 2014). The richness found in the BHAC may be associated with broad environmental heterogeneity, since the basin is formed by a large variety of ecosystems (rivers, streams, wetlands and reservoir). Landscapes with different lotic, lentic and semilentic aquatic systems tend to present larger functional habitats and greater microhabitat diversity for fishes, increasing the availability of feeding resources, breeding sites and refuges against predation (Matthews 1998). BHAC also showed high species diversity compared to similar studies in aquatic systems. For example, in the coastal streams of austral Brazil, Bastos et al. (2013) recorded a total of 41 species, while Artioli et al. (2009) documented the occurrence of 52 species in Mangueira Lagoon, located in the same coastal plain, with the largest values comparable to those found in other aquatic environments in southern Brazil (Lucena et al. 1994, Tagliani 1994, Malabarba et al. 2009, Carvalho et al. 2012). Lower numbers of species in the studies described above can be associated with the type of sampler, as well as lower environmental heterogeneity; however, the outstanding abundance of Characiformes and Siluriformes are documented for every location (Artioli et al. 2009, Carvalho et al. 2012, Bastos et al. 2013, Silva et al. 2014).

Table 2. Taxonomic list of the 83 species de fishes, collected during August/2012 and July/2013, in six sites in the hydrographic basin of Chasqueiro stream, Mirim Lagoon system, southern Brazil. With respective order, family, species and voucher number. The number is the identification of each picture of figure 3.

Orden/Family/Species	Number	Upstream		Downstream		Reservoir		Voucher number
		S1	S2	S3	S4	S5	S6	
Clupeiformes								
Clupeidae								
Platanichthys platana (Regan, 1917)	1	X			X	X	X	0043
Characiformes								
Acestrorhynchidae								
Acestrorhynchus pantaneiro Menezes, 1992	2				X			0061
Characidae								
Astyanax dissensus (Lucena et al. 2013)	3			X				0063
Astyanax laticeps (Cope, 1894)	4	X	X		X			0064
Astyanax eigenmanniorum (Cope, 1894)	5	X	X	X	X	X	X	0003
Astyanax aff. *fasciatus* (Cuvier,1819)	6			X	X	X	X	0008
Astyanax henseli Melo & Buckup, 2006	7			X	X	X		0005
Astyanax jacuhiensis (Cope, 1894)	8			X	X		X	0018
Astyanax spp.	9			X				0062
Bryconamericus iheringii (Boulenger, 1887)	10	X	X	X	X	X	X	0034
Charax stenopterus (Cope, 1894)	11			X	X	X	X	0009
Cheirodon ibicuhiensis Eigenmann, 1915	12	X	X	X	X	X	X	0054
Cheirodon interruptus (Jenyns, 1842)	13	X	X	X	X	X	X	0024
Cyanocharax alburnus (Hensel, 1870)	14	X	X	X	X	X	X	0015
Diapoma speculiferum Cope, 1894	15				X			0074
Heterocheirodon jacuiensis Malabarba & Bertaco, 1999	16	X		X	X	X	X	0049
Hyphessobrycon boulengeri (Eigenmann, 1907)	17	X		X	X			0052
Hyphessobrycon igneus Miquelarena, Menni, López & Casciotta, 1980	18			X	X			0081
Hyphessobrycon luetkenii (Boulenger, 1887)	19	X	X	X	X	X	X	0007
Hyphessobrycon meridionalis Ringuelet, Miquelarena & Menni, 1978	20			X	X			0019
Macropsobrycon uruguayanae Eigenmann,1915	21			X				0050
Mimagoniates inequalis Eigenmann, 1911	22	X	X					0047
Oligosarcus jenynsii (Günther, 1864)	23			X	X	X	X	0059
Oligosarcus robustus Menezes, 1969	24			X	X	X	X	0028
Pseudocorynopoma doriae Perugia, 1891	25	X	X	X	X	X		0011
Crenuchidae								
Characidium orientale Buckup & Reis, 1997	26	X	X	X	X			0033
Characidium pterostictum Gomes, 1947	27	X	X					0037
Characidium rachovii Regan, 1913	28			X	X			0016
Characidium tenue (Cope, 1894)	29	X		X	X			0022
Curimatidae								
Cyphocharax saladensis (Meinken, 1933)	30			X	X			0077
Cyphocharax spilotus (Vari, 1987)	31			X	X			0044

Continued on next page

Table 2. Continued.

Orden/Family/Species	**Number**	**Upstream**		**Downstream**		**Reservoir**		**Voucher number**
		S1	**S2**	**S3**	**S4**	**S5**	**S6**	
Cyphocharax voga (Hensel, 1864)	32	X		X	X	X	X	0001
Steindachnerina biornata (Braga & Azpelicueta, 1987)	33			X	X			0083
Erythrinidae								
Hoplias aff. *malabaricus* (Bloch, 1794)	34			X	X	X	X	0029
Siluriformes								
Auchenipteridae								
Trachelyopterus lucenai Bertoletti, Pezzi da Silva & Pereira, 1995	35			X	X			0041
Callichthyidae								
Corydoras paleatus (Jenyns, 1842)	36	X	X	X	X	X	X	0030
Callichthys callichthys (Linnaeus, 1758)	37			X				0026
Heptapteridae								
Heptapterus mustelinus (Valenciennes in d'Orbigny, 1835)	38	X	X	X				0035
Pimellodela australis Eigenmann, 1917	39	X	X	X	X	X	X	0012
Rhamdia quelen (Quoy & Gaimard, 1824)	40			X	X	X	X	0084
Loricariidae								
Ancistrus brevipinnis (Regan, 1904)	41		X			X	X	0067
Hisonotus armatus (Carvalho et al. 2008)	42			X	X			0040
Hisonotus spp.	43			X				0068
Hisonotus taimensis (Buckup, 1981)	44			X				0069
Hisonotus cf. *notopagos* Carvalho & Reis, 2011	45			X	X			0065
Hisonotus laevior Cope, 1894	46	X	X	X	X			0039
Hisonotus nigricauda (Boulenger, 1891)	47	X	X	X	X	X		0076
Hypostomus commersoni Valenciennes, 1836	48	X	X			X	X	0014
Loricariichthys anus (Valenciennes, 1836)	49	X				X	X	0045
Otothyris rostrata Garavello, Britski & Schaefer, 1998	50			X				0066
Otocinclus flexilis Cope, 1894	51	X		X				0010
Rineloricaria baliola Rodriguez & Reis, 2008	52	X	X	X	X			0056
Rineloricaria cadeae (Hensel, 1868)	53	X	X	X	X			0021
Rineloricaria longicauda Reis, 1983	54	X	X	X	X			0057
Rineloricaria microlepidogaster (Regan, 1904)	55	X	X	X	X			0006
Rineloricaria strigilata (Hensel, 1868)	56	X	X					0070
Pseudopimelodidae								
Microglanis cottoides (Boulenger, 1891)	57	X	X	X	X			0023
Trichomycteridae								
Homodiaetus anisitsi Eigenmann & Ward, 1907	58	X	X	X	X	X	X	0048
Scleronema cf. *angustirostri* (Davincenzi, 1942)	59	X	X	X				0032
Aspredinidae								

Continued on next page

Table 2. Continued.

Orden/Family/Species	Number	Upstream		Downstream		Reservoir		Voucher number
		S1	S2	S3	S4	S5	S6	
Pseudobunocephalus iheringii (Boulenger 1891)	60	X	X	X	X			0038
Pimelodidae								
Parapimelodus nigribarbis (Boulenger, 1889)	61					X	X	0025
Pimelodus pintado Azpelicueta, Lundberg & Loureiro, 2008	62			X				0058
Gymnotiformes								
Gymnotidae								
Gymnotus pantherinus (Steindachner, 1908)	63		X					0072
Gymnotus aff. carapo Linnaeus, 1758	64			X				0027
Hypopomidae								
Brachyhypopomus bombilla (Loureiro & Silva, 2006)	65			X				0042
Brachyhypopomus draco Giora, Malabarba & Crampton, 2008	66			X				0082
Brachyhypopomus gauderio Giora & Malabarba, 2009	67			X	X			0075
Sternopygidae								
Eigenmannia trilineata López & Castello, 1966	68				X			0060
Cyprinodontiformes								
Anablepidae								
Jenynsia multidentata (Jenyns, 1842)	69	X	X	X		X	X	0013
Jenynsia onca (Lucinda, Reis & Quevedo, 2002)	70	X						0080
Poeciliidae								
Cnesterodon decemmaculatus (Jenyns, 1842)	71			X	X			0053
Phalloceros caudimaculatus (Hensel, 1868)	72	X	X	X	X			0017
Phalloceros aff. *caudimaculatus* (Hensel, 1868).	73			X				0071
Phalloptychus cf. *iheringii* (Boulenger, 1889)	74			X				0073
Atheriniformes								
Atherinopsidae								
Odontesthes spp.	75					X	X	0046
Perciformes								
Cichlidae								
Australoheros acaroides (Hensel, 1870)	76			X	X			0036
Cichlasoma portalegrense (Hensel, 1870)	77			X				0055
Geophagus brasiliensis (Quoy & Gaimard, 1824)	78	X		X	X	X	X	0004
Gymnogeophagus gymnogenys Hensel, 1870	79	X	X	X	X	X	X	0020
Gymnogeophagus rhabdotus Hensel, 1870	80	X		X	X	X		0002
Crenicichla lepidota Heckel, 1840	81	X	X	X	X	X	X	0078
Crenicichla punctata Hensel, 1870	82				X	X	X	0079
Synbranchiformes								
Synbranchidae								
Synbranchus marmoratus Bloch, 1785	83	X	X	X				0031
Taxa		**47**	**33**	**67**	**53**	**31**	**28**	
Shannon_H		**2.57**	**2.22**	**3.00**	**2.83**	**2.04**	**2.09**	
Equitability_J		**0.71**	**0.64**	**0.75**	**0.72**	**0.60**	**0.63**	

Figure 4. Picture of the 83 species of fishes collected in the hydrographic basin Chasqueiro Stream, Mirim Lagoon system, southern Brazil.

The downstream biotope presented the greatest richness, which may be related to increased diversity of habitats and micro habitats observed in this biotope, which corroborates the river continuum theory (Vannote et al. 1980), where changes along the longitudinal gradient (upstream to downstream) tend to increase the biological diversity. This is related to higher solar incidence and temperature variations, which increase structural complexity, e.g. the presence of macrophytes with this higher primary productivity. Another aspect that may influence the increase in fish diversity in a hydrographic basin is the presence of environmental barriers. Winemiller et al. (2008) explain that environmental barriers limit dispersion, which tends to influence diversity along a longitudinal gradient. Therefore, this study provides important data about ecosystems that compose the hydrographic basin of Chasqueiro Stream. Indeed, the richer biotopes were upstream and downstream, where there was better ecological and functional structure. Furthermore, there was a strong predominance of Characiformes and Siluriformes, reflecting the environmental heterogeneity of these environments. Downstream environments were

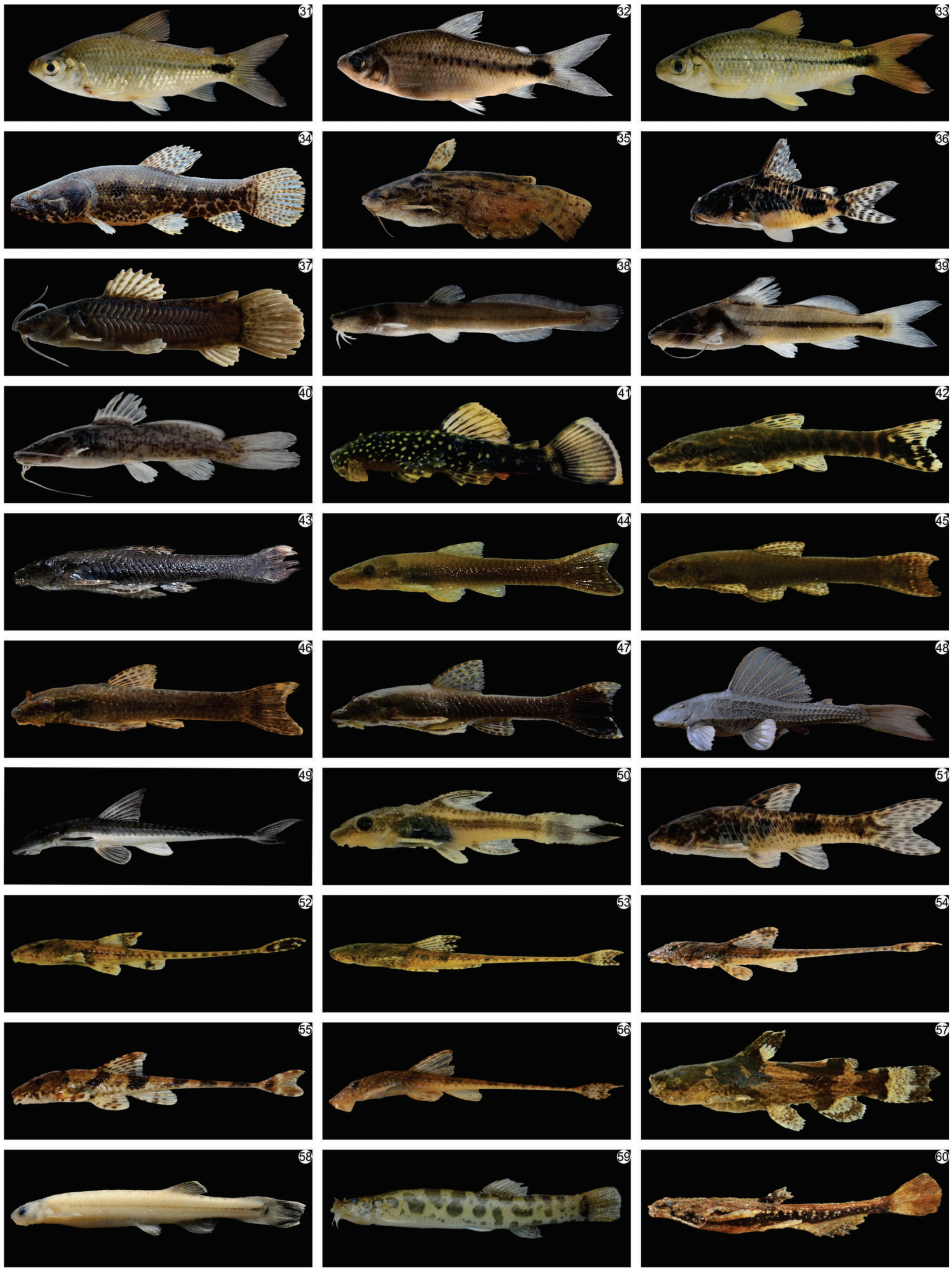

Figure 4. Continued.

more susceptible to environmental degradation caused mainly by rice cultivation.

However, the reservoir has the lowest diversity, reflecting a more homogeneous environment and the presence of invasive species (e.g. *Odonthestes* spp.) (Figure 4). The information mentioned above can be used for management plans and regional conservation, adopting mitigation measures for the preservation of this important ecosystem in southern Brazil. Further studies about the spatial and temporal distribution of species can help answer important questions about the dynamics of the assemblage organization, as well as provide additional assistance for formulating conservation programs for the ichthyofauna basin and greater control over environmental impacts, such as those resulting from irrigation and rice cultivation.

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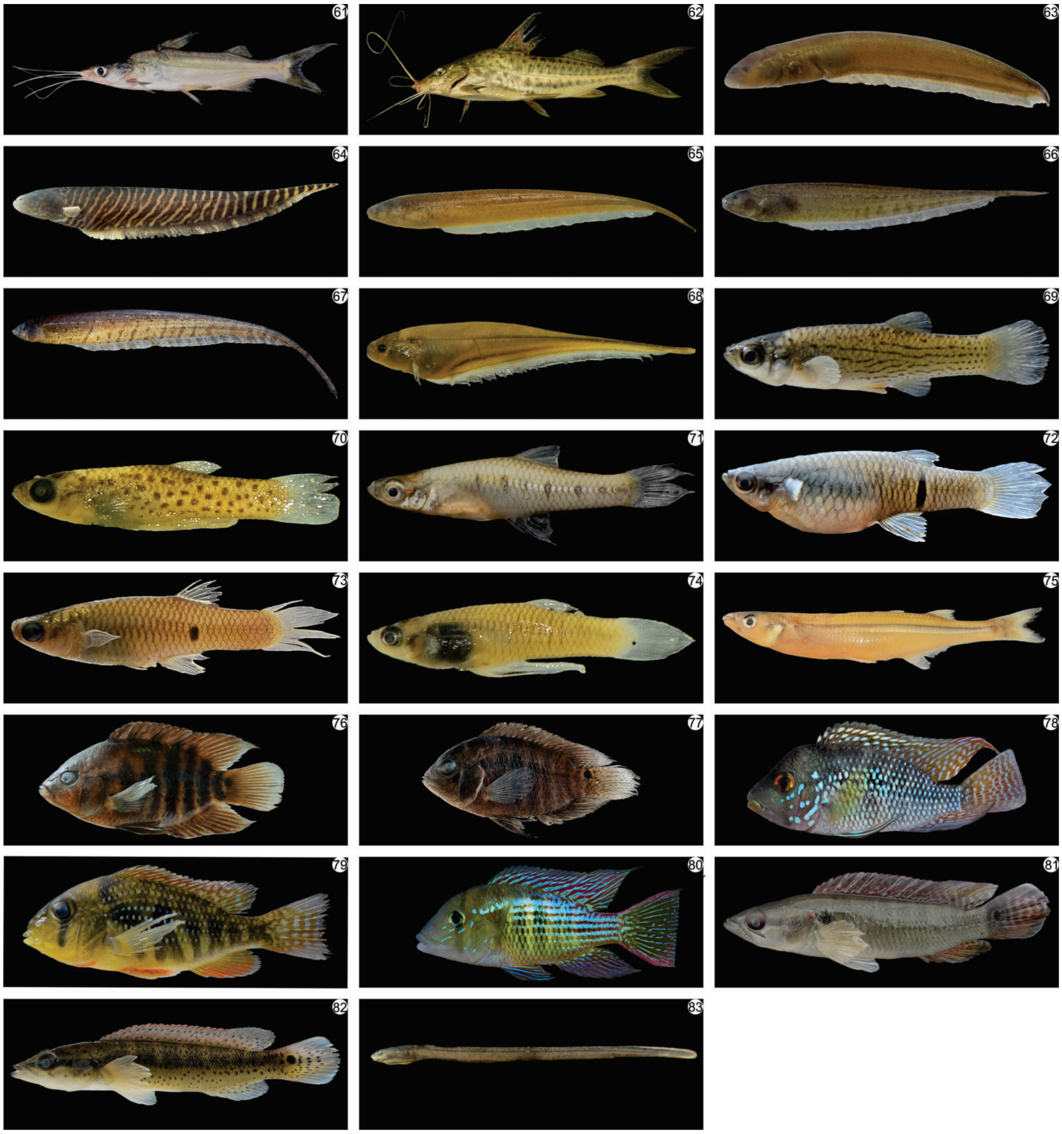

Figure 4. Continued.

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erratum

Erratum: Ichthyofauna of the hydrographic basin of Chasqueiro Stream (Mirim Lagoon system, southern Brazil): generating subsidies for conservation and management

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