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The fish fauna in tropical rivers: The case of the Sorocaba river basin, SP, Brazil

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Abstract: A survey was carried out on the fish species in the Sorocaba River basin, the main tributary of the left margin of the Tietê River, located in the State of São Paulo, Brazil. The species were collected with gill nets. After identification of the specimens, their relative abundance, weight and standard length were determined. Up to the present moment there are not any studies that focus this subject in this hydrographic basin. Fifty-three species, distributed in eighteen families and six orders were collected. Characiformes were represented by twenty-eight species, Siluriformes by seventeen species, the Gymnotiformes by three species, Perciformes and Cyprinodontiformes by two species, and the Synbranchiformes by one species. Among the collected species there were two exotic. The most abundant species were *Astyanax fasciatus* and *Hypostomus ancistroides*. In relation to total weight the most representative species were *Hoplias malabaricus* and *Hypostomus ancistroides. Cyprinus carpio, Prochilodus lineatus, Schizodon nasutus* and *Hoplias malabaricus* were the most representative species in relation to average weight. Largest standard length were recorded for *Sternopygus macrurus, Steindachnerina insculpta, Eigenmannia aff. virescens* and *Cyprinus carpio.*

Key words: freshwater fishes, spatial distribution, Sorocaba River, lagoon, reservoir, Brazil.

Vari and Malabarba (1998) proposed that the number of species in South and Central America could rise to 5600. There are 3228 fish species in South America (Gery 1969). Lowe-McConnel (1969) reported 1383 identified species in Brazil, distributed in 46 families. The orders Siluriformes and Characiformes are dominant. Britski (1972) emphasizes that Characidae is the most representative family of freshwater fishes in Brazil. It is estimated that in South America there are 58 families of Teleostei (Lowe-McConnel 1975).

In the State of São Paulo, Brazil, Castro and Menezes (1998) report the existence of 261 freshwater fish species distributed in 22 families (Britski 1972). Recently Castro and Menezes (1998) registered 25 families of fishes, where the order Siluriformes prevail over the others, and Characiformes was the second most important (Castro and Menezes 1998).

Many authors have focused the studies of the ichthyofauna of rivers of the Tietê River basin (Godoy 1975, Caramaschi 1986, Castro and Arcifa 1987, Barrela, 1989, Barrela and Petrere 1994, Barrela, 1998 and Smith, 1999). According to Bizerril (1996), despite the increase of publications on ecological aspects of fish communities in South America, a comprehensive knowledge is still incipient.

Furthermore, due to the explosive growth of human population there is an increasing need to explore water resources, especially

regarding the use of the water of the rivers as energy source, water supply and to dilute domestic and industrial effluents. Aquatic ecosystems suffer a deep impacts due to these activities. In this case, the ichthyofauna composition is constantly changing and some unknown might disappear or become rare. Therefore, knowing the ichthyofauna of a river basin is the first step to future studies, such as monitoring projects, regarding fish conservation and its application to studies regarding polluttion control (Smith *et al*. 1997).

The lack of studies about fish fauna and its ecological characteristics in the Sorocaba River basin is a known fact. Thus, this study has the objective to know about the composition of the fish species in Sorocaba river basin, its distribution along the basin and to characterize its main species.

MATERIAL AND METHODS

There are 18 cities in the drainage area of 5269 km^2 of the Sorocaba river basin, located in the State of São Paulo (Anonymous 1990). This hydrographic basin is constituted by Sorocaba River, which is mainly formed by the rivers Sorocamirim and Sorocabuçu and its main tributary rivers the Tatuí, Sarapuí, Pirajibú, and Ipanema rivers. Samples were collected in thirteen stations located in seven rivers, being four points along the Sorocaba River (so01, so02, so03 e so04), three points in the Ipanema River (ip01, ip02 e ip03), two points in the Sarapuí River (sa01 e sa02) and one point in the rivers Tatuí (ta01), Pirajibú (pj01) and Pirapora (pi01) (Fig. 1). From those, eleven are lotics kind and two are lentic kind. The so01 station is a reservoir and so03 station is a marginal lagoon (Table 1).

The fish sampling consisted of 26 campaigns in 13 collecting stations. Samples were collected at each site in the dry and rainy seasons. Two batteries of gill nets with 8 nets of 10 meters in length and 1.5 meters in width, and different meshes (3, 4, 5, 6, 7, 8, 10, and 12 cm between opposite knots) were used to catch fish. Fishes were measured, weighed and fixed in 10% formaline solution, preserved in 70% alcohol and identified according to Britsky (1972). The identification of the species was confirmed by Heraldo Britski, Zoology Museum, University of São Paulo.

Information about species composition, number of individuals, weight and standard length for each specimen was recorded for each collecting station. The species inventory was complemented with the information about species described in the marginal lagoons of the Sorocaba River by Smith and Barrella (1994) and data from reports of Environmental

TABLE 1
Characterization of the collecting stations, their location, ecological status and geographical coordinates (according to Smith 1999)

Collecting stations	River	City	Ecological status	Geographical coordinates
pi01	Pirapora	Salto de Pirapora	Lotic, polluted	23º38'27"S 47º34'25"W
ip01	Ipanema	Salto de Pirapora	Lotic, polluted	23º34'56"S 47º29'30"W
ip02	Ipanema	Araçoiaba da Serra	Lotic	23º28'35"S 47º46'30"W
ip03	Ipanema	Iperó	Lotic	23º24'56"S 47º46'30"W
so01	Sorocaba	Ibíuna	Dammed (reservoir)	23º36'34"S 47º18'05"W
so02	Sorocaba	Votorantim	Lotic, polluted	23º32'01"S 47º26'33"W
so03	Sorocaba	Sorocaba	Marginal lagoons	23º26'10"S 47º26'28"W
so04	Sorocaba	Cerquilho	Lotic	23º09'35"S 47º47'22"W
ta01	Tatuí	Tatuí	Lotic, polluted	23º21'45"S 47º48'30"W
rm01	Macacos river	Sarapuí	Dammed	23º33'21"S 47º47'15"W
pj01	Pirajibú	Sorocaba	Lotic, polluted	23º25'30"S 47º21'15"W
sa01	Sarapuí	Sarapuí	Lotic	23º33'12"S 47º46'42"W
sa02	Sarapuí	Tatuí	Lotic	23º24'02"S 47º45'32"W

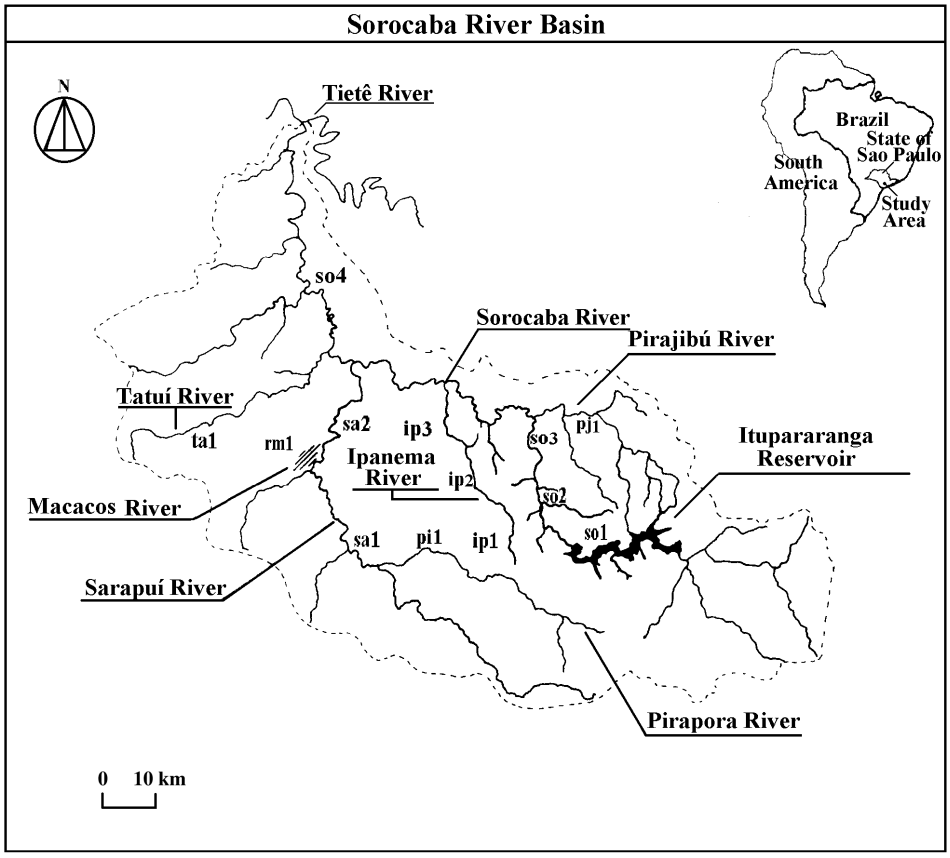

Fig. 1. General aspects of the Sorocaba River basin and collecting stations location.

Impacts conducted in this hydrographic basin in 1993 in rivers Ipanema e Sorocaba. These data were only used to describe the ichthyofauna and were calculated the constancy ocorrence of species. Resident species were the ones present in more than 50% of the collections, accessory present in 25 to 50% of the collections and accidental, present in fewer than 25% of the collections (Dajos 1983). Information for fish diet and reproduction were gathered in the current literature.

RESULTS

Inventory of the Ichthyofauna. In this work 53 fish species were identified in the basin, distributed in 18 families and 6 orders (Table 2). Characiformes was represented by 28 species, 52.8% of the total of species collected. It was followed by Siluriformes with 17 species (32.1%); Gymnotiformes with 3 species (5.7%) of the total; Perciformes and Cipronodontiformes with 2 species, both representing 3.8% of the total; and Synbranchiformes with one specie corresponding to 1.8% of the total number of species.

Of these species, 96.2% are natives, only 3.8% are exotic. Besides 64.8% of species are captured for fishing in the basin. The professional fishery is incipient while sport fishery is practiced by larger amount of people. Many people utilize the fishes as food.

The distribution of the Ichthyofauna along the basin. Table 3 shows the species that were identified in the basin and the places where they occur. It is possible to describe the

TABLE 2
List of species and their occurrence in the Sorocaba River basin

Order/Family	Species	Occurrence (River)
CHARACIFORMES		
CHARACIDAE		
Tetragonopterinae		
	Astyanax fasciatus	Sorocaba, Pirapora, Tatuí, Sarapuí, Ipanema and Pirajibú
	Astyanax altiparanae	Sorocaba, Pirajibú, Tatuí, Sarapuí, Ipanema and Macacos stream
	Astyanax sp.	Ipanema e Pirajibú
	Astyanax eigenmaniorum	Sorocaba
	Astyanax scabripinnis	Ferro stream
	Hemigrammus marginatus	Ferro stream and Marginal lagoons
Cheirodontinae	*Bryconamericus* sp	Sorocaba
	Odontostilbe notomelas	Ipanema
	Cheirodon notomelas	Marginal lagoons
	Cheirodon sp.	Ferro stream
Acestrorhynchinae	*Acestrorhynchus lacustris*	Sorocaba, Sarapuí, Ipanema and Macacos stream
	Oligossarcus paranensis	Ipanema and Sorocaba
Characinae	*Galeocharax knerii*	Sorocaba and Ipanema
Salmininae	*Salminus hilarii*	Sorocaba, Sarapuí and Ipanema
Serrassalminae	*Serrasalmus spilopleura*	Sorocaba and Macacos stream
CRENUCHIDAE		
Characidiinae	*Characidium fasciatum*	Marginal lagoons
	Characidium zebra	Macacos stream
ERYTHRINIDAE		
	Hoplias malabaricus	Sorocaba, Pirapora, Tatuí, Sarapuí, Ipanema and Macacos stream
PROCHILODONTIDAE		
	Prochilodus lineatus	Marginal lagoons, Sorocaba, Tatuí, Sarapuí, Ipanema and Macacos stream
CURIMATIDAE		
	Steindachnerina insculpta	Sarapuí, Sorocaba and Ipanema
	Cyphocharax modestus	Sarapuí, Sorocaba, Ipanema and Pirapora
	Cyphocharax nagelli	Sorocaba
ANOSTOMIDAE		
	Leporinus obtusidens	Sarapuí and Sorocaba
	Leporinus striatus	Sorocaba
	Schizodon nasutus	Sarapuí and Sorocaba
PARODONTIDAE		
	Parodon tortuosus	Sorocaba, Ipanema and Pirapora
	Apareiodon piracicabae	Sarapuí, Sorocaba and Pirapora

TABLE 2 (*continued…*)
List of species and their occurrence in the Sorocaba River basin

Order/Family	Species	Occurrence (River)
CYPRINIFORMES		
CIPRINIDAE		
	Cyprinus carpio	Sorocaba
SILURIFORMES		
CALLICHTHYIDAE		
	Corydoras aeneus	Ferro stream and Aparecidinha
	Callicthys callichtys	Sorocaba and Sarapuí
	Hoplosternum litoralle	Marginal lagoons, Sorocaba, Tatuí and Macacos stream
PIMELODIDAE		
	Imparfinis mirini	Sorocaba
	Pimelodella sp	Sorocaba, Pirajibú, Ipanema Pirapora and Sarapuí
	Pimelodus maculatus	Sarapuí and Sorocaba
	Iheringichthys labrosus	Sorocaba and Ipanema
	Rhamdia quelen	Ipanema and Sorocaba
TRICHOMYCTERIDAE		
	Trichomycterus sp	Streams of headwaters of Itupararanga reservoir
LORICARIIDAE		
	Microlepidogaster depressicauda	Ipanema
	Hypostomus sp A	Pirapora and Sorocaba
	Hypostomus sp B	Pirapora and Sorocaba
	Hypostomus sp C	Ipanema
	Hypostomus margaritifer	Ipanema, Tatuí, Pirapora and Sorocaba
	Hypostomus ancistroides	Ipanema, Tatuí, Pirapora Sorocaba and Sarapuí
	Rineloricaria sp A	Ipanema
	Rineloricaria latirostris	Sarapuí and Ipanema
GYMNOTIFORMES		
GYMNOTIDAE		
	Gymnotus carapo	Marginal lagoons, Sorocaba, Tatuí, Sarapuí, Ipanema and Macacos stream
STERNOPYGIDAE		
	Sternopygus macrurus	Sorocaba
	Eigenmannia aff. *virescens*	Ipanema
PERCIFORMES		
CICHLIDAE		
	Oreochromis niloticus	Sorocaba, Ipanema and Marginal lagoons
	Geophagus brasiliensis	Sorocaba, Tatuí, Ipanema, Macacos stream, Pirapora and Ferro stream
CYPRINODONTIFORMES		
POECILIIDAE		
	Phalloceros caudimaculatus	Large distribution
	Poecilia vivipara	Ferro stream and Marginal lagoons
SYNBRANCHIFORMES		
SYNBRANCHIDAE		
	Synbranchus marmoratus	Marginal lagoons

TABLE 3
Distribution of fish species in the differents aquatics habitats in the Sorocaba River basin, São Paulo, Brazil

Species	**wide distribution**	**Head streams**	**lotic and long river stretch**	**reservoirs**	**marginal lagoons**	**marginal habitats**	**lentic**	**polluted segments of the river**
Astyanax fasciatus	X			X		X		
Astyanax altiparanae	X					X		
Astyanax sp.			X					
Astyanax eigenmaniorum			X					
Astyanax scabripinnis		X						
Hemigrammus marginatus		X			X	X		
Odontostilbe notomelas			X					
Bryconamericus sp.						X		
Cheirodon notomelas					X	X		
Cheirodon sp.		X						
Acestrorhynchus lacustris	X		X	X				
Galeocharax knerii			X					
Oligossarcus paranensis			X	X			X	
Salminus hilarii			X					
Serrasalmus spilopleura						X	X	
Characidium fasciatum					X	X		
Characidium zebra		X						
Hoplias malabaricus	X			X			X	
Prochilodus lineatus			X		X			
Steindachnerina insculpta			X				X	
Cyphocharax modestus	X			X			X	
Cyphocharax nagelli			X				X	
Leporinus obtusidens			X					
Leporinus striatus			X					
Apareiodon piracicabae			X					
Parodon tortuosus			X					
Schizodon nasutus			X					
Corydoras aeneus		X					X	
Callichthys callichthys							X	X
Hoplosternum litoralle				X				X
Gymnotus carapo	X			X		X		
Sternopygus macrurus			X	X				
Eigenmannia aff. *virescens*			X	X				
Imparfinis migrini		X	X					
Pimelodella sp.		X	X					
Pimelodus maculatus			X	X				
Iheringichthys labrosus			X	X			X	
Rhamdia quelen			X	X				
Rhamdia hilarii			X					
Microlepidogaster depressicauda			X			X		
Trichomycterus sp.		X						
Hypostomus sp A			X					X
Hypostomus sp B			X					X
Hypostomus sp C			X					X
Hypostomus margaritifer			X					X
Hypostomus ancistroides		X	X	X				X
Rineloricaria sp A			X		X			
Rineloricaria latirostris			X					
Oreochromis niloticus				X	X	X	X	
Geophagus brasiliensis	X	X		X		X	X	
Phalloceros caudimaculatus	X	X				X	X	
Poecilia vivipara		X			X	X	X	
Synbranchus marmoratus					X			
Cyprinus carpio				X			X	

distribution of the ichthyofauna along the rivers, lagoons and reservoirs of the basin as follows:

Widely distributed in the basin: species were found in all the streams, rivers, lagoons and reservoirs such as *Hoplias malabaricus, Astyanax fasciatus, Astyanax altiparanae, Prochilodus lineatus, Gymnotus carapo, Geophagus brasiliensis* and *Phaloceros caudimaculatus.*

Species were restricted to or more frequently found in headwater streams: *Trichomycterus* sp, *Cheirodon* sp*, Astyanax scabripinnis, Corydoras aeneus* and *Characidium zebra*. These species were collected in tributary streams of "Itupararanga" reservoir, "Ribeirão do Ferro" and other stream.

Species were restricted to lentic environments: they were collected in the "Itupararanga" reservoir, marginal lagoons and stillwater: *Cyprinus carpio, Synbranchus marmoratus, Oreochromis niloticus* and *Cyphocarax modestus.*

Species that prefer lotic environments: they were found in the rivers Sorocaba, Tatuí, Sarapuí and Pirapora, *Hypostomus ancistroides, Hypostomus margaritifer, Prochilodus lineatus, Leporinus striatus, Leporinus obtusidens, Schizodon nasutus* and *Apareiodon piracicabae* belong to this group.

Species that prefer long stretches of river: among this group are *Salminus hilarii, Iheringichthys labrosus, Galeocharax knerii, Pimelodus maculatus,* and *Schizodon nasutus.* They were found in the rivers Sorocaba, Tatuí, Sarapuí and Ipanema.

Species that benefit of disturbed environments: these species were collected mainly in the Tatuí River and the Sorocaba River. *Hoplosternum litoralle, Callichthys callichthys,* and two species of *Hypostmous* (*Hypostomus ancistroides* and *Hypostomus margaritifer*) belong to this group.

Small sized fishes that inhabit the margins of rivers and lagoons, living under the protection of macrophytes and marginal vegetation: these species were found in most of the basin aquatic environment. The species exhibiting these characteristics are: *Corydoras aeneus, Cheirodon notomelas, Cheirodon* sp*, Chara-cidium fasciatum, Hemigrammus marginatus, Phaloceros caudimaculatus* and *Poecilia vivipara.*

Species that are adapted to reservoirs: species found in the "Itupararanga" reservoir are: *Cyphocharax modestus, Astyanax fasciatus, Oreochromis niloticus* and *Geophagus brasiliensis*.

Figure 2 shows the species richness in the four habitats. River are the richest ones, followed by marginal lagoons. The reservoir present the lesser richness, perhaps due to habitat change. Headstreams are also poor mostly due to resource limitation and niche availability and geological traits.

Characterization of the Ichthyofauna in the present study. A total of 626 individuals were collected; corresponding to a total fish weight of 79.0 kg, belonging to 37 species distributed in 28 genera, 4 orders and 15 families of teleosts fishes. The Characiforms are the most representative group contributing with 46.0% of the species, followed by Siluriformes (37.8%), Gymnotiformes (8.1%) and Perciformes (5.4%) and Cypriniformes (2.7%). Among the families, Characidae and Loricaridae are noticed, both with 18.4% and Pimelodidade with 15.8% of the collected species.

The abundance, average standard length, total and average weight of each captured species are shown in Table 4. The Characidae family is the most abundant family in the Sorocaba River Basin, dominating its rivers and

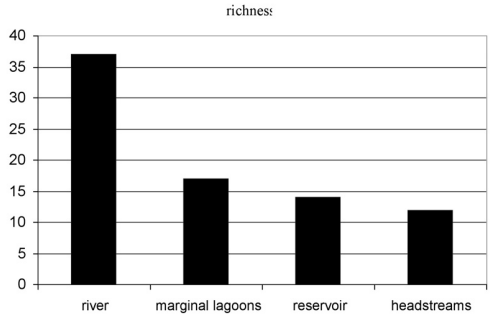

Fig. 2. Species richness of the fishes in the gour habitats: river, marginal lagoons, reservoir and headstreams.

TABLE 4
Fish species and their respective scientific names; individual abundance (N); average standard length (ASL); total weight in grams (TW) and average weight in grams (AWG) of individuals in the collection

Species	N	ASL	TW	AWG
Hoplias malabaricus	80	20.33	15010	187.6
Astyanax fasciatus	318	8.1	2825	8.9
Astyanax altiparanae	141	6.4	907	6.4
Astyanax sp.	16	6	120	7.5
Serrasalmus spilopleura	6	11.4	378	63
Prochilodus lineatus	36	21.9	8797	244.4
Gymnotus carapo	16	18.8	875	48.6
Eigenmannia sp.	5	30.8	250	50
Callichthys callichthys	5	10.7	205	41
Hoplosternum litoralle	118	10.3	5820	49.3
Acestrorhynchus lacustris	111	14.9	4885	44
Galeocharax knerii	10	12.5	410	41
Salminus hilarii	11	15.9	790	71.8
Ooreochromis niloticus	12	11.3	1160	96.6
Geophagus brasiliensis	53	11.2	2870	54.2
Rhamdia sp.	8	9.2	235	29.3
Pimelodella sp.	2	10	10	5
Pimelodus maculatus	2	12	10	5
Iheringichthys labrosus	24	14.2	930	38.8
Schizodon nasutus	8	19.2	1505	188
Leporinus obtusidens	6	7.2	630	105
Parodon tortuosus	11	10	155	14
Apareiodon cf. *piracicabae*	50	11.6	1335	26.7
Steindachnerina insculpta	60	33.9	837.5	14
Cyphocharax modestus	124	10.6	2926.6	23.6
Rineloricaria latirostris	11	13.9	115	10.4
Hypostomus margaritifer	63	15.45	6643.5	105.5
Hypostomus ancistroides	239	13.4	11888.2	49.7
Cyphocharax nagelli	1	12.5	320	45.7
Cyprinus carpio	1	27	530	530
Rhamdia quelen	30	12.8	95	33.7
Oligossarcus paranensis	13	12.1	215	16.5
Hypostomus sp A	4	13.5	415	58.3
Hypostomus sp B	26	18.3	3940	151.5
Hypostomus sp C	2	8.2	10	5
Rineloricaria sp A	3	14.5	70	23.3
Sternopygus macrurus	2	41.5	190	95

lagoons. The family has 7 species, grouped in 4 genera, where *Astyanax* was the most abundant and widely distributed species of this family. Among the Siluriformes, the most important families in number of species were the Loricaridae and Pimelodidade with 7 and 5 genera, respectively. The genus *Hypostomus* (Loricaridae) was the most captured. The next family is the Curimatidae with 2 genera and 2 species, among them the *Cyphocharax* is the most abundant.

Overall, the Characidae and Loricaridae presented the highest relative abundance of individuals, with 38% and 21.4% respectively, followed by the Curimatidade family with 11.4%. The most important families in relative weight, was Loricaridae and Erythrinidae that presented highest percentages in total weight of 29.0% and 19.0%, respectively (Fig. 3).

The most abundant species were the *Astyanax fasciatus* and the *Hypostomus*

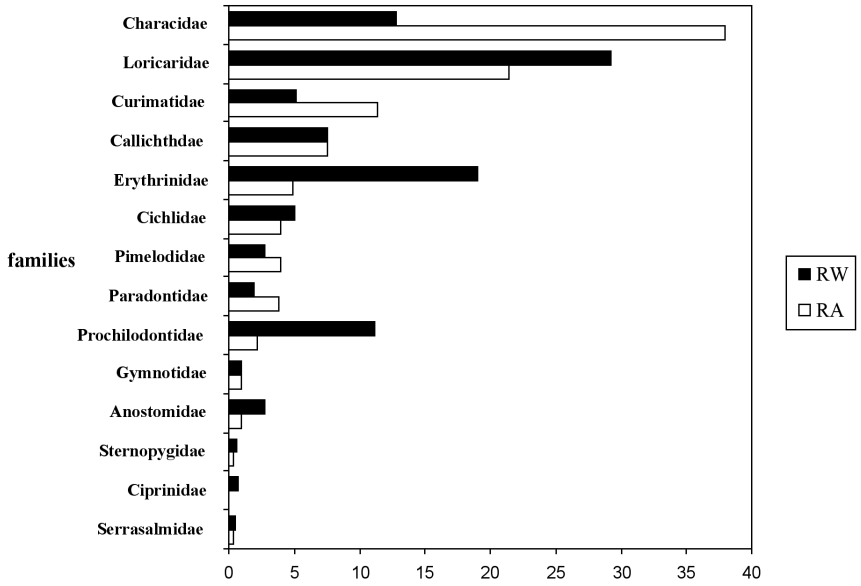

Fig. 3. Relative Abundance (RA) and Relative Weight (RW) of the fish families in the Sorocaba River basin community.

ancistroides with 318 and 239 individuals. The less abundant species in the basin were the *Cyprinus carpio* and *Cyphocharax nagelli* with only one individual. The most representative species in relation to weight were the *Hoplias malabaricus* with 15 g and the *Hypostomus ancistroides* with 11.9 g (Table 4).

The species that presented the largest average standard length were *Sternopygus macrurus* with 41.5 cm, *Steindachnerina insculpta* with 33.9 cm, *Eigenmannia* aff. *virescens* with 30.8 cm and *Cyprinus carpio* with 27 cm. The smallest captured species were *Astyanax* sp with 6 cm and *Astyanax altiparanae* with 6.2 cm. In general, the species that showed the highest abundance had the smallest average standard length, whereas the species with the largest average standard length were less abundant (Table 4).

In the entire collection, the most representative species in respect to average weight were *Cyprinus carpio* with 530 g, *Prochilodus lineatus* with 244.4 g, *Schizodon nasutus* and *Hoplias malabaricus* with 188 and 187.6 g, respectively. The species with the lowest weight values were *Pimelodella* sp, *Pimelodus maculat*us and the *Hypostomus* sp C, all with 5 g (Table 4). The most common species at the collecting stations was *Hypostomus ancistroides* present in 78% of the collected samples and distributed in most of the streams and rivers, marginal lagoons and in the Itupararanga reservoir. *Hoplias malabaricus*, *Astyanax fasciatus* and *Astyanax altiparanae* were captured in 69.2% of the collected samples. These species were also widely distributed in streams, rivers, lagoons and reservoir of the basin (Table 3).

When considering the collecting stations, *Astyanax altiparanae* was present in 11 of the 13 collecting stations. *Hoplias malabaricus*, *Astyanax fasciatus* and *Hypostomus ancistroides* were present in 10 of the 13 stations sampled and showed the widest spatial distribution in the basin. The species that presented a restricted distribution were *Pimelodella* sp, *Pimelodus maculatus*, *Cyphocharax nagelli*, *Cyprinus carpio*, *Hypostomus* sp C and *Sternopygus macrurus*). Specimens of these species were captured at the station sa02, sa01, so01,so01, so04 and ip03, respectively.

Hoplias malabaricus, *Astyanax fasciatus*, *Astyanax altiparanae*, *Prochilodus lineatus*,

Gymnotus carapo, *Geophagus brasiliensis* and *Hypostomus ancistroides* were considered residents (present in more than 50% of the collections), *Astyanax* sp, *Hoplosternum litoralle*, *Acestrorhynchus lacustris*, *Salminus hilarii*, *Tilapia nilotica*, *Iheringichthys labrosus*, *Steindachnerina insculpta*, *Cyphocharax modestus* and *Hypostomus margaritifer* acessory (present in 25% to 50% of the collections) and *Serrasalmus spilopleura*, *Eigenmannia* sp, *Galeocharax knerii*, *Rhamdia* sp, *Pimelodella* sp, *Pimelodus maculatus*, *Schizodon nasutus*, *Leporinus obtusidens*, *Parodon tortuosus*, *Apareiodon piracicabae*, *Rineloricaria latirostris*, *Cyphocharax nagelli*, *Cyprinus carpio*, *Oligossarcus paranensis*, *Hyspostomus* sp A, *Hypostomus* sp B, *Hypostomus* sp C, *Rineloricaria* sp A and *Sternopygus macrurus* accidental (present in fewer than 25% of the collections).

The exotic species present in the Sorocaba River basin seem to be restricted to habitats with low hydrodynamics such as lagoons and reservoirs. *Cyprinus carpio* and *Oreochromis niloticus* are the 2 species captured in the basin natural environment. *Oreochromis niloticus* was the most abundant specie captured in 3 stations, while the carp was present in only one station. *Hoplosternum litoralle* is considered exotic (accidental introduction) for some ichthyologists (Britski, personal communication).

Characterization of the main species. The species of genus *Astyanax* (*Astyanax fasciatus*, *Astyanax altiparanae, Astyanax cabripinnis* and *Astyanax eigenmaniorum*) are omnivorous fishes with great alimentary flexibility (Agostinho and Julio Jr 1999), and it is widely distributied in the Sorocaba river basin. These species exibit external fecundation, are not migratory and do not present parental care (Vazzoler and Menezes, 1992). *Astyanax fasciatus* present total spawining and *Astyanax altiparanae* present parcelled spawining (Vazzoler and Menezes 1992). These species are omnivorous, forager, with feed flexibility and have wide distribution in the Latin America (Nelson 1984 apud Castro and Arcifa 1987). *Astyanax scabripinnis* just occur in headwater streams.

Cyphocharax modestus and *Steindachnerina insculpta* are iliophagous species when adults and plancthophagous when young (Castro and Arcifa 1987). They are adapted to colonize lentics habitats, do are not migratory, do not present parental care and are parcelled spawners. *Prochilodus lineatus* present external fecundation, is migratory and present parental care (Vazzoler and Menezes 1992). *Serrasalmus spilopleura* is not migratory, present parental care and utilize the "aguapé" (*Eichhornia* sp.) and other macrophytes for laying eggs (Castro and Arcifa 1987, Thomaz and Bini 1999). Their diet is predominant piscivore.

Hoplias malabaricus show a wide distribution in rivers, lagoons and reservoir of the basin. This species present parcelled spawning (Vazzoler and Menezes 1992) and parental care, prefering lentic habitats. *Salminus hilarii* is a migratory species with parental care and total spawining, while *Acestrorhynchus lacustris* and *Schizodon nasutus* are not migratory and do not care for the offspring (Vazzoler and Menezes 1992). The species of genus *Parodon* and *Apareiodon* occur in lotic habitats. These species are parcelled spawning.

The species of genus *Hypostomus* prefer lotics habitats (Uieda 1983), parcelled spawning and herbivorous or iliophagous diet. In countampart *Rhamdia quelen* and *Pimelodus maculatus* are parcelled spawning and are carnivorous. These species are abundant in rivers, principally in lotic habitats. The interesting species is *Hoplosternum litoralle*, very abundant in locals with increase concentration of organic composed and low water oxynation. This specie is adapted to live in impacted habitats because present saculiforms structures in intestinal alces, than facilitate gaseous exchange (Kramer 1987). The gretat abundance of *Hoplosternum litoralle* in marginal lagoons is due to its increased endurance to lowd dissolved oxygen concentration (Agostinho and Julio Jr. 1999). *Geophagus brasiliensis* is a species with wide distribution in the basin, presenting omnivore diet, parental care and use the substratum to spawn (Castro and Arcifa 1987).

DISCUSSION

The fish fauna of the Sorocaba River basin showed similarities with reported data of the other studies. Its ichthyofauna was dominated by Characiformes and Siluriformes with 28 and 20 species, respectively. The Characidae family was the most representative. Matthews (1998) observed that there are many species per family in temperate river assemblages. On the other hand, in tropical river assemblages there are few species per family, but many families. In the Sorocaba River basin it was not different, 14 families were found, some of them represented by only one species, as observed with Prochilodontidae, Serrasalmidae, and Erythrinidae, among others.

Matthews (1998) also stresses that the successs of a family in a tropical river is due to its availability food, habitats and general resources. When compared to other basins, the results obtained in this study show that there are a high number of families in the Sorocaba River basin, especially if the limited number of samples and the little knowledge of the ichthyofauna of this basin are taken into account.

The ichthyofauna of the Sorocaba River is characterized by omnivorous, carnivorous, iliophagus and herbivorous (algae and plants) species; no herbivorous species specialized in fruits or seeds were collected. Agostinho and Julio Jr (1999) say that in the High Parana Basin, where Sorocaba Basin is included, piscivorous and iliophagous species are dominant.

Furthermore, species that depend on organic matter imported from the riparian forest for feeding, reproduction and shelter (Castro and Menezes 1998) are in disadvantage due to intense deforesting of the area (Smith 1999). As example we can refer to *Brycon sp*, which should occur in the basin, albeit not caught, it was reported in the area (Britsky 1972). Arcifa (1987) warns for the reduction of fish population that relies in riparian vegetation resources such as seeds, fruits and insects.

Besides the lost of the riparian vegetation other impacts occurred in the basin as domestic and industrial sewage, draining of floodplain lakes, exotic species introduction, etc. (Smith and Barrella 2000, Smith and Petrere 2000). Amoung the species which were not caught due to these causes are the species of the subfamily Sorubiminae how *Pseudoplatystoma corruscans*, *Hemisorubim platyrhynchos* and *Paulicea luetkeni*. These species were documented for the Piracicaba River (another affluent of Tiete river by the right margin) (Monteiro, 1953), Mogi-Guassu river (Rio Grande basin), (Schubart 1962) and for the Stete of Sao Paulo (Britskii 1972). Moreover some species presented characteristics which allowed them to stay in these polluted places as *Hoplosternum litoralle*, *Hypostomus ancistroides* among other. These species exhibit accessory respiration being considered resistent to low dissolved oxygen.

The ichthyofauna spatial distribution shown in this paper is in accordance with several other published works in other hydrographic basins, if environmental characteristics are considered. Species that are less demanding for food and reproduction, such as *Hoplias malabaricus, Astyanax fasciatus, Astyanax altiparanae, Geophagus brasiliensis* and *Phaloceros caudimaculatus*, show a wide geographic distribution. It was already shown that these species are the most common in rivers, streams and lagoons in the State of São Paulo (Britski 1972). In addition to these widely distributed species, there are species that are usually found in specific environments.

Castro and Arcifa (1987) emphasized the dominance of *Cyphocharax modestus* and *Astyanax fasciatus* in reservoirs of the State of São Paulo. This is the same result that was obtained in the Itupararanga reservoir.

Besides the species that were well adapted to the reservoir environment, there are those species that are typical to lotic environments such as *Hypostomus ancistroides, Hypostomus margaritifer, Prochilodus lineatus, Leporinus striatus, Leporinus obtusidens, Schizodon nasutus* and *Apareiodon piracicabae.* Britski (1972), Nomura (1984) and Uieda (1995) characterized the genus *Hypostomus* as vegetarians

and inhabitants of flowing water sites. Nomura (1984) also describes the genus *Apareiodon* as a preferential inhabitant of these.

At this point, the capture of "corimbatá" *(Prochilodus lineatus*) in marginal lagoons must be emphasized. The presence of this specie, typical of riverbeds, in marginal lagoons suggests that these lagoons have the role of fish nurseries (Godoy 1995) due to food and shelter availability (Veríssimo 1994) and also to food sources for adult individuals. According to Smith and Barrella (2000) the most abundant species and weight is *Prochilodus lineatus* and *Hoplias malabaricus*, confirmed by Lowe-McConell (1987). Smith and Barrella (2000) also state that low size specimens as *Phaloceros caudimaculatus*, *Geophagus brasiliensis* and Serrapinus notomelas are very abundant.

In the Sorocaba River basin there are several headwater streams that should be studied. In these streams *Trichomycterus* sp and *Astyanax scabripinnis* were captured and characterized as typical species of this environment (Britski 1997, personal comm.). Agostinho and Julio Jr (1999) also state that Astyanax scabripinnis is typical creek specie. According to Menezes (1998, personal comm.), the unknown Brazilian ichthyofauna is concentrated in the headwater streams.

The ichthyofauna differences between collecting stations or even between the aquatic habitats studied are related to the different abiotic gradients observed along the river; habitat diversity (Vannote *et al*. 1980, Johnson *et al*. 1995); the influence of current velocity and river size (Meffe and Sheldon 1988) depth and kind of substract (Bain *et al*. 1988) and waterland interface (Schlosser 1995). The amount of resources such as shelters, food and number of habitats contributes to emphasize differences between stations, thus influencing the structure of fish communities (Schreck and Moyle 1990), since each environment has its own characteristics (Barrela and Petrere 1994).

Besides the kind of environment (lotic or lentic) can influence fish abundance and distribution. *Hoplias malabaricus, Hoplosternum litoralle*, *Oreochromis niloticus*, *Astyanax fasciatus*, *Geophagus brasiliensis* and *Cyphocharax modestus* were more abundant in lentic habitats than in lotic ones. These species prefer lagoons, reservoirs and backwaters (Britki 1972, Castro and Arcifa 1987), as rm01, so01 and so03 station. In counterpart *Hypostomus margaritifer*, *Hypostomus ancistroides, Rineloricaria latirostris*, *Rhamdia quelen*, *Salminus hilarii*, *Pimelodus maculatus* and *Leporinus obtusidens* prefer lotic habitats (Agostinho and Julio Jr. 1999). These species were more abundant in station with current as pi01, so02, so04 and ip03.

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RESUMEN

Se realizó un análisis de las especies de peces de la cuenca del Río Sorocaba, el principal tributario de la margen izquierda del Río Tietê, localizado en el estado de Sao Paulo, Brasil. Las especies fueron recolectadas con redes agalleras. Luego de la identificación de los especímenes, fue determinada su abundancia relativa, peso, y longitud estandar. Hasta el presente, no hay ningún otro estudio que analice estos aspectos en dicha cuenca hidrográfica. Fueron recolectados 55 especies, distribuidas en 18 familias y 6 ordenes. Los Characiformes estuvieron representados por 28 especies, Siluriformes por 17 especies, Gymnotiformes por 3 especies, Perciformes y Cyprinodontiformes por 2 especies, y Synbranchiformes por una especie. Entre estas, se encontró 2 especies exóticas. Las especies más abundantes fueron *Astyanax fasciatus* y *Hypostomus ancistroides*. En relación con el peso total, la especie más representativas fueron *Hoplias malabaricus* y *Hypostomus ancistroides*. En tanto que, *Cyprinus carpio, Prochilodus lineatus, Schizodon nasutus* y *Hoplias malabaricus* fueron las más representativas en relación al preso promedio. Las longitudes estandar más grandes fue encontradas en *Sternopygus macrurus, Steindachnerina insculpta, Eigenmannia aff. virescens* y *Cyprinus carpio.*

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