Fish community structure of Juramento reservoir, São Francisco River basin, Minas Gerais, Brazil

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ABSTRACT. Many rivers in Brazil as the São Francisco (SFR) have been impounded for reservoirs construction purposes. However, there is a lack of knowledge on their fish fauna in many areas, including headwaters. The present study aimed to describe the fish community structure from Juramento reservoir, located on Juramento River, a branch of SFR basin. Six bimonthly samplings were made in four different sites. Gill and cast nets, beach seines and sieves were used to collect fish. Ecological indexes as well as the relationship between fish abundance and some limnological variables were determined. 3288 fish belonging to 33 species (16.5% of the total described for SFR basin) were captured, being 75.7% Characiformes, 18.1% Siluriformes, 3% Cyprinodontiformes and 3% Gymnotiformes. Only two non-native species, 'tamboatá' – *Hoplosternum littorale* (Hancock, 1828) and 'trairão' – *Hoplias lacerdae* Ribeiro, 1908 were found. The highest catches in number occurred in the dry period (March-October) and the lowest one in the wet season (November-February). Diversity was higher at Barragem station and richness did not vary between reservoir zones. Five migratory species were found downstream of the dam (four exclusively there), whereas only the 'curimbatá-pioa' – *Prochilodus costatus* Valenciennes, 1850 occurred in the reservoir. The low observed correlations between fish abundance and the limnological variables utilized suggest that the local fish fauna is not strongly affected by their variation.
KEY WORDS. Fish diversity.

RESUMO. **Estrutura da comunidade de peixes do reservatório de Juramento, bacia do Rio São Francisco, Minas Gerais, Brasil.** No Brasil, vários rios, como os da bacia do São Francisco (RSF), são barrados para a formação de reservatórios. Entretanto, o estudo desta ictiofauna, especialmente a dos rios de cabeceira, ainda deixa a desejar. O presente estudo descreveu a estrutura da ictiofauna do reservatório de Juramento, Rio Juramento, bacia do RSF. Foram realizadas seis coletas bimestrais em quatro locais empregando-se redes de emalhar, tarrafas, arrastões e peneiras. Foram determinados índices ecológicos e a relação entre abundância da ictiofauna e algumas variáveis limnológicas do reservatório. Foram capturados 3288 exemplares, pertencentes a 33 espécies (16,5% das descritas para a bacia do RSF), sendo 75,7% Characiformes, 18,1% Siluriformes, 3% Cyprinodontiformes e 3% Gymnotiformes. Apenas 2 espécies exóticas, tamboatá – *Hoplosternum littorale* (Hancock, 1828) – e trairão – *Hoplias lacerdae* Ribeiro, 1908 – foram capturadas. As maiores capturas em número ocorreram no período seco (março-outubro) e a menor durante a estação chuvosa (novembro-fevereiro). A diversidade foi maior em Barragem e a riqueza específica não variou entre as regiões do reservatório. Cinco espécies migradoras ocorreram a jusante (quatro exclusivamente ali), e apenas uma – *Prochilodus costatus* Valenciennes, 1850 – a montante. As baixas correlações entre a abundância de peixes e as variáveis limnológicas utilizadas, sugerem estar a ictiofauna local menos sujeita às alterações relacionadas a estas variáveis.
PALAVRAS-CHAVE. Diversidade de peixes.

Among the Brazilian rivers, the São Francisco (SFR) is distinguished for its extension, volume, economic and environmental importance. Its basin covers an area of 631,133 km^2 (Planvasf 1989) representing 7.5% of Brazilian territory. During its course of nearly 3,000 km from Espinhaço range toward the Atlantic Ocean, the SFR crosses through five States (Minas Gerais, Bahia, Pernambuco, Sergipe and Alagoas) and three important biomas ('Cerrado', 'Caatinga' and Atlantic Forest) (Copasa 2001). Its central segment, from Pirapora city (Minas Gerais State) to Sobradinho reservoir (Bahia), comprises an area of 1,090 km plenty of marginal lagoons and floodplains, and produces overflows that can spread out to 84 km (average of 9

km) from its margins, as occurs at Xique-Xique (Bahia). The SFR floodplains areas are very important for fish recruitment, especially for migratory species nursery habitat (Pompeu & Godinho 2003, Sato & Godinho 2003). These species are among the more important ones to commercial fisheries, and allow the SFR to support an expressive fishery activity. Besides, mineral substances as lead, zinc, gold, silver, cadmium, chromium, quartz and sulfur have been extracted from that basin (Copasa 2001).

Studies involving SFR basin fish fauna are gradually increasing, calling attention, among other, some papers on inventory (Britski *et al*. 1986, Sato & Godinho 1999), community structure (Alves & Vono 1997, Alves & Pompeu 2001), food habits (Pompeu 1999, Pompeu & Godinho 2003, Oliveira *et al*. 2004) and fisheries (Godinho *et al*. 2003, Sato & Godinho 2003).

However, information concerning the fish fauna of the SFR upper drainages, especially related to impounded areas, is poorly available yet. This is the current status of the Juramento reservoir, located in the headwaters of the Verde Grande river, where just one preliminary inventory (Dabés *et al*. 2001) had been made. As the main water supplier for Montes Claros city (Minas Gerais), Southeastern Brazil, the study of its fish fauna is important to support the future management plan and the species conservation of that area.

The aims of the present study were to describe the structure of reservoir fish community. The species composition, spatial and temporal variations on the species abundance (in number and biomass), the assemblage constancy, richness, diversity and similarity between the sampled sites were determined. This study also intended to relate the reservoir fish abundance with some limnological variables.

MATERIAL AND METHODS

Study area

The Juramento reservoir (16º46'20"S e 43º39'56"W) is owned by COPASA (Companhia de Saneamento de Minas Gerais). It was formed in 1981 by the Juramento river impoundment and has two tributaries (Saracura and Canoas rivers). Located 5 km far from Verde Grande river, it has a flooded area of 7.63 km^2, 9.1 m of mean depth and a total volume of 45 billions of liters. The reservoir was built in 1981 for supplying Montes Claros city, 27 km away. Currently, it is responsible for 70% of the total water supplied to that city. Juramento has a perimeter of 52 km at 640.3 m, surrounded by 31 km^2 of protected woody area. Its basin vegetation is characterized mainly by 'Cerrado' formations and pastures (Dabés *et al*. 2001).

Sampling

Four sampling locals were defined in the study area: (1) Barragem, which represents the reservoir lentic zone; (2) Canoas, the transition region; (3) Juramento, the lotic area, and (4) Jusante, downstream the reservoir in front of the dam (Fig. 1).

Six bimonthly samplings were made for each upstream station from March 2002 to February 2003. Fish were caught using gill nets with mesh sizes from 3 to 16 cm (opposite knots length) soaked for 15 hours per station (from 16:00 PM to 7:00 AM). After this period, the nets were removed of water and all the fish captured were gathered by mesh size. Beach seines (2 mm diameter), sieves (2 mm) and cast nets (7 cm) were also utilized.

In Jusante station it was not possible to apply the same sampling effort utilized upstream due to local limitations. Thus, just qualitative sampling was made there, using cast nets (7 cm between opposite knots), gill nets (7-8 cm), beach seines and sieves (2 mm diameter).

In the field, specimens were identified, labeled and stored in 10% formaldehyde solution. In laboratory, from each specimen was obtained the standard length (cm) and body weight (g). A small representative fraction of sampled fish has been deposited at Pontifícia Universidade Católica de Minas Gerais (PUCMinas). Few specimens were sent to Museu de Zoologia, Pontifícia Universidade Católica do Rio Grande do Sul, (PUC-RS) for taxonomic confirmations.

Data on water temperature, conductivity, pH, transparency, and dissolved oxygen from the stations upstream the dam were also collected by COPASA staff, from 9:15 to 10:55 AM at 0.5 m deep, from February 2002 to February 2003.

Catches in number and biomass

For the species captured by gill nets, fish abundance was determined through the capture per unit of effort (CPUE), defined as the sum of the number (CPUEn) or biomass (CPUEb) of captured fish by 100 m^2 of nets soaked for 12 hours. This procedure allowed quantitative comparisons between species, stations and dry (March to October) and wet seasons (November to February). Before the analyses, two normality tests (Kolmogorov-Smirnov and Lillifors & Shapiro-Wilks) were performed on abundance data. A one-way ANOVA was carried out to verify eventual significant abundance differences between the sampled stations, and a Tukey test was also applied when appropriated. A student t-test for independent samples was performed to verify significant differences in the abundance between dry and wet seasons. A 0.05 significance level was established for all tests utilized.

Ecological parameters

The cumulative curve of the species captured with gill nets was drawing along the sampling period to verify the influence of the number of samples on the species richness, following Boschung & O'neil (1981), among other. The species constancy was calculated according to Dajoz (1973), for all the sampled stations including all species captured. The following categories were established: constant (equal or more than 50%), accessory (equal or more than 25% and less than 50%) and accidental (less than 25%). The total number of species captured with gill nets was used as a richness index for each sampled station. Diversity was calculated using two different indexes that are not highly affected by sample size and that consider the relative abundance of each species to determine the diversity value

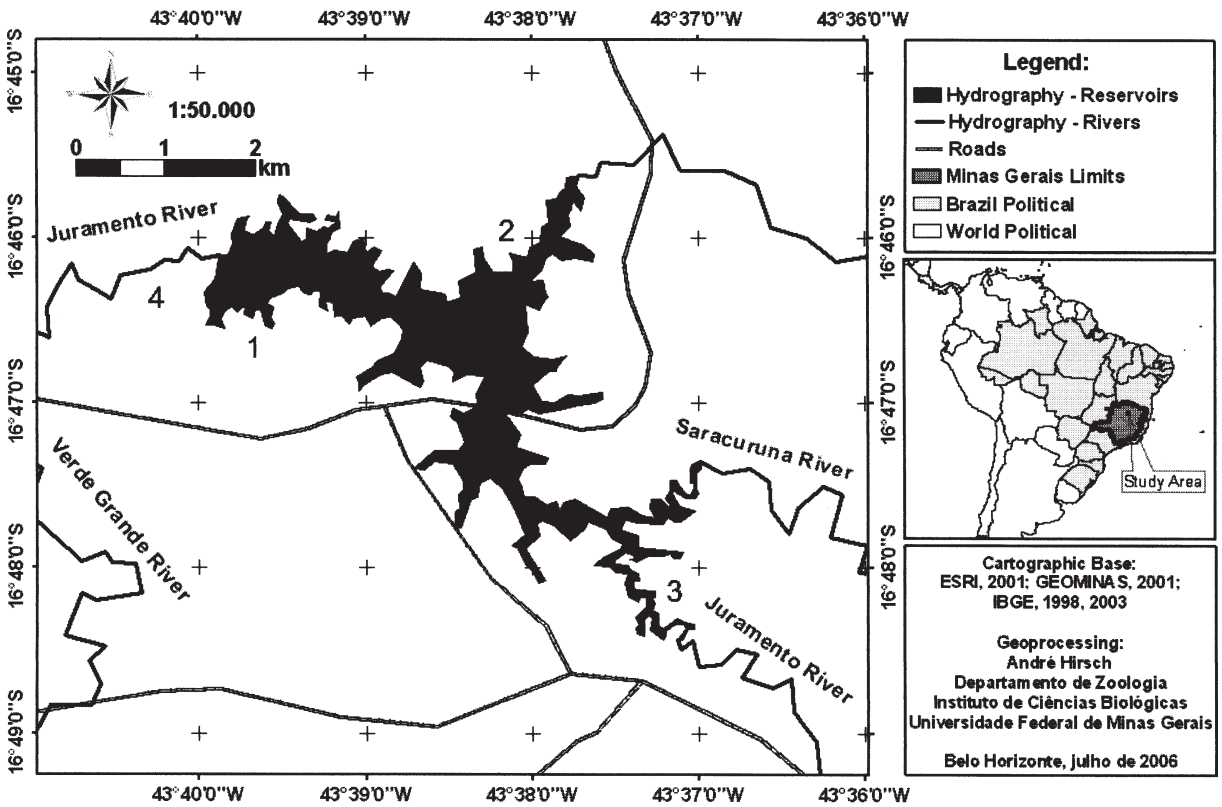

Figure 1. Juramento reservoir with the sampled areas: (1) Barragem, (2) Canoas, (3) Juramento, and (4) Jusante.

(Magurran 2004). The Shannon index (*H'*) is represented by the equation $H' = - \Sigma[(ni/N).Ln(ni/N)]$, where: (ni) number of fishes of the ieth species found in a given local, (N) total number of fishes captured in a given local, and (ln) natural logarithm. The Simpson index (1/D), is considered a measure of dominance, being sensible to the most abundant species. It is represented by the equation $D = \Sigma (ni (ni - 1))/N (N - 1)$, where: (ni) number of individuals of a given species and (N) total number of individuals. The evenness index (E) is derived from the Shannon index and was calculated using the equation $E = H'/\log S$, where S = total number of species.

The resemblance between all the sampled stations was estimated through the Jaccard similarity index, following Magurran (2004), taking in account only the species presence/absence.

Fish abundance and limnological variables

To detect eventual relationships between the limnological variables utilized and fish abundance, a Principal Component Analysis (PCA) was performed over a matrix of previously log-transformed limnological data, according to Ter Braak (1995). To avoid bias, only the components with eigenvalues greater than 1 were used for analyses, as pointed out by Jackson (1993). To detect eventual patterns in the association degree, Pearson correlations were carried out between the principal axis and the log-transformed CPUEn values for each sampling and station.

RESULTS

A total of 3288 specimens were captured, belonging to 33 species and four different Orders. Twenty-five species (75.7%) were Characiformes, whereas six (18.2%) belonged to Siluriformes. Gymnotiformes and Cyprinodontiformes were represented by only one species each. Five species were found only upstream of the dam and 10 only downstream. From six Siluriformes species, five were only captured downstream, representing 50% of the species found exclusively at Jusante station (Tab. I).

The species cumulative curve showed a tendency to stabilization after the fifth sampling (November-December) (Fig. 2).

The CPUEn and CPUEb values between stations and seasons were not significant for the normality tests. No significant differences were also found for abundance (in number or biomass) between dry and wet seasons. Significant differences ($p < 0.05$) in CPUEn were only found between Canoas station and the other (Tab. II).

The 'pirambeba' *Serrasalmus brandtii* (Lutken, 1875) was the most captured species, corresponding to 22.4% of the all catches, followed by *Curimatella lepidura* (Eigenmann &

Table I. Fish species occurrence in the sampling sites of Juramento reservoir area, from March 2002 to February 2003. (Jus) Jusante, (Bar) Barragem, (Can) Canoas, (Jur) Juramento, (1) Qualitative captured species only, (2) Downstream captured species only, (3) Upstream captured species only, (4) Migratory species, (5) São Francisco river basin introduced species.

Species	Local name	Sites			
		Jus	Bar	Can	Jur
Characiformes					
Acestrorhynchus lacustris (Lütken,1875)	Peixe-cachorro	+	+	+	+
Apareiodon piracicabae (Eigenmann, 1907)	Canivete (1)	+	+	+	–
Astyanax bimaculatus (Linnaeus, 1785)	Lambari-rabo-amarelo	+	+	+	+
Astyanax fasciatus (Cuvier, 1819)	Lambari-rabo-vermelho (1)	+	+	–	+
Brycon orthotaenia Günther, 1864	Matrinchã (2, 4)	+	–	–	–
Bryconamericus stramineus Eigenmann, 1908	Piaba (1)	+	+	–	–
Compsura heterura Eigenmann, 1915	Piabinha (1)	+	+	+	–
Curimatella lepidura (Eigenmann & Eigenmann, 1889)	Manjuba (3)	–	+	+	+
Hoplias lacerdae Ribeiro,1908	Trairão (5)	+	+	+	–
Hoplias malabaricus (Bloch, 1794)	Traíra	+	+	+	+
Leporinus elongatus Valenciennes, 1850	Piau-verdadeiro (2, 4)	+	–	–	–
Leporinus piau Fowler, 1941	Piau-gordura (2)	+	–	–	–
Leporinus taeniatus Lütken, 1875	Piau-jejo (3)	–	+	+	+
Moenkhausia costae (Steindachner, 1907)	Piaba (1)	+	+	+	+
Phenacogaster fransciscoensis Eigenmann, 1911	Piaba (1,3)	–	+	–	–
Piabina argentea Reinhardt, 1867	Piaba (1)	+	+	+	–
Prochilodus costatus Valenciennes, 1850	Curimatá-pioa (4)	+	+	+	+
Prochilodus argenteus Agassiz, 1829	Curimatá-pacu (2, 4)	+	–	–	–
Pygocentrus piraya (Cuvier, 1819)	Piranha	+	+	+	+
Roeboides xenodon Reinhardt, 1851	Piaba (1)	+	+	–	+
Salminus brasiliensis (Cuvier, 1816)	Dourado (2, 4)	+	–	–	–
Schizodon knerii (Steindachner, 1875)	Piau-branco	+	+	+	+
Serrasalmus brandtii (Lütken, 1875)	Pirambeba	+	+	+	+
Steindachnerina elegans (Steindachner, 1874)	Sagüiru (3)	–	+	+	+
Tetragonopterus chalceus Spix & Agassiz, 1829	Piaba-rapadura	+	+	+	+
Cyprinodontiformes					
Poecilia vivipara Bloch & Schneider, 1801	Barrigudinho (1)	+	+	–	+
Gymnotiformes					
Eigenmannia virescens (Valenciennes, 1842)	Sarapó (1)	+	+	–	+
Siluriformes					
Otocinclus xakriaba Schaefer, 1997	Cascudo (2)	+	–	–	–
Hoplosternum littorale (Hancock, 1828)	Tamboatá (1, 2, 5)	+	–	–	–
Hypostomus commersonii Valenciennes, 1836	Cascudo (3)	–	–	+	–
Hypostomus macrops (Eigenmann & Eigenmann, 1888)	Cascudo (2)	+	–	–	–
Pimelodus maculatus La Cépede, 1803	Mandi-amarelo (2)	+	–	–	–
Rhinelepis aspera Spix & Agassiz, 1829	Cascudo (2)	+	–	–	–

Eigenmann, 1889) (20.1%), *Tetragonopterus chalceus* Spix & Agassiz, 1829 (18.1%) and *Acestrorhynchus lacustris* (Lutken, 1875) (16.5%). Captures in biomass were also highest for *S. brandtii* (24,2% of the whole sampled weight), followed by *A. lacustris* (18.9%), *Schizodon knerii* (Steindachner, 1874) (15.7%) and *C. lepidura* (10.7%) (Fig. 3).

At upstream stations, 23 species were captured. Of these, 13 were considered constant, three accessories and seven acci-

Table II. Calculated Student t test (t) and ANOVA F test (F) values, based on bimonthly captures in number (CPUEn) and biomass (CPUEb), among seasons (dry and wet) and samplings sites in Juramento reservoir, from March 2002 to February 2003. Significant values ($p < 0.05$) are in bold. (sd) Standard deviation, (M) mean, (N) number of samples, (A, B) post hoc comparisons among sites by performing a Tukey test. Sites with same letters have no significant abundances.

	Periods			Sites			
	Dry	Wet	t	Barragem	Canoas	Juramento	F
CPUEn							
N	4	2	1.0	6	6	6	**5.9**
M	855.7	742.0		373.1	601.7	368.3	
sd	156.7	0.568		113.0	137.4	149.1	
				A	**B**	**A**	
CPUEb (g)							
N	4	2	0.3	6	6	6	2.8
M	5858.8	5646.5		33529.6	41760.4	29972.9	
sd	1023.3	488.6		8562.2	5595.4	11425.7	

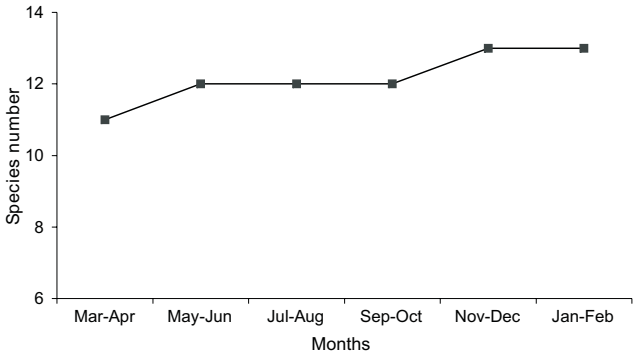

Figure 2. Fish species accumulation curve for Juramento reservoir from March 2002 to February 2003.

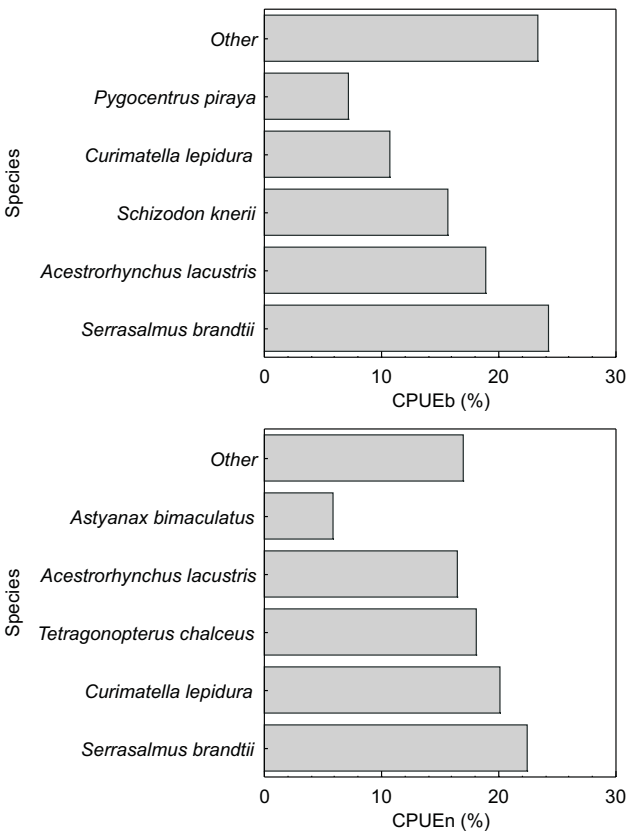

Figure 3. Percent of the total catch per unit of effort in biomass (CPUEb) and in number (CPUEn) from the captured species in Juramento reservoir, from March 2002 to February 2003.

dental. At the Jusante station, 28 species occurred, 11 of them being accidental, 10 constant and seven accessories (Tab. III). Considering only the quantitative sampling, 12 species were identified at Barragem, 13 at Canoas and 11 at Juramento. Barragem showed the highest diversity values, according to Shannon and Simpson indexes, although with small differences in relation to other stations. Nevertheless, the Shannon index t test was significant ($p < 0.05$) between Barragem and the other reservoir regions. The evenness values were also similar between stations (Tab. IV). Barragem and Juramento showed the most similarity, followed by Barragem and Canoas. Smaller values were obtained among Canoas/Juramento and Jusante stations (Tab. V).

Only the first two axis presented eigenvalues greater than one (PCI = 1.91; PCII = 1.61), explaining together 70.5% of the total variance. PCI was related to water transparency, dissolved oxygen and pH, while PCII described the conductivity influence. A plot of these two components described an environmental gradient explained by PCI that put samples with higher values of DO, pH and transparency at one side, and those showing low values for these variables in the opposite; and another

Table III. Constancy for the species upstream and downstream of the Juramento dam study area, collected from March 2002 to February 2003. (Cn) Constant, (Ac) Accessory, (Ai) Accidental.

Species	Constancy	
	Upstream	Downstream
Acestrorhynchus lacustris	Cn	Ac
Astyanax bimaculatus	Cn	Cn
Compsura heterura	Cn	–
Curimatella lepidura	Cn	–
Hoplias lacerdae	Cn	Ai
Hoplias malabaricus	Cn	Ai
Leporinus taeniatus	Cn	–
Prochilodus costatus	Cn	Cn
Pygocentrus piraya	Cn	Ac
Schizodon knerii	Cn	Cn
Serrasalmus brandtii	Cn	Cn
Steindachnerina elegans	Cn	–
Tetragonopterus chalceus	Cn	Ai
Apareiodon piracicabae	Ac	Ac
Bryconamericus stramineus	Ac	Ac
Piabina argentea	Ac	Ac
Astyanax fasciatus	Ai	Cn
Eigenmannia virescens	Ai	Ai
Hypostomus commersonii	Ai	–
Moenkhausia costae	Ai	Ai
Phenacogaster franciscoensis	Ai	Cn
Poecilia vivipara	Ai	Ac
Roeboides xenodon	Ai	Ai
Brycon orthotaenia	–	Ai
Hoplosternum littorale	–	Ac
Hypostomus macrops	–	Ai
Leporinus elongatus	–	Cn
Leporinus piau	–	Ai
Otocinclus xakriaba	–	Cn
Pimelodus maculatus	–	Cn
Prochilodus argenteus	–	Cn
Rhinelepis aspera	–	Ai
Salminus brasiliensis	–	Ai

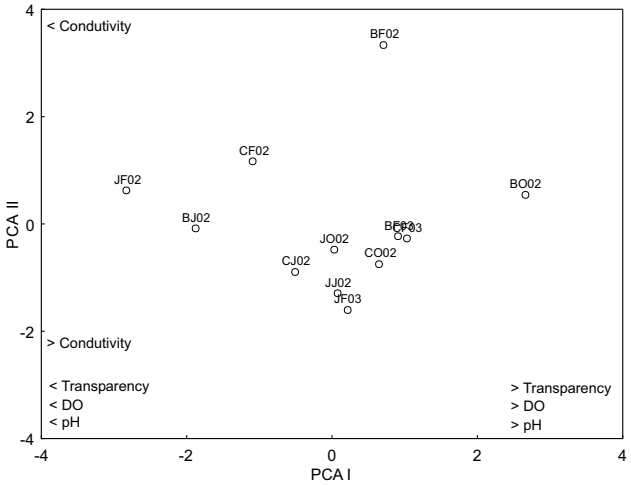

Figure 4. PCA I and PCA II axes obtained from the limnological matrix data by site/bimester for Juramento reservoir. (B) Barragem, (J) Juramento, (C) Canoas, (F) February, (J) June, (O) October, (02) 2002, (03) 2003.

Table IV. Species richness, diversities and evenness indexes estimated for upstream sampled sites of Juramento reservoir from March 2002 to February 2003 (Shannon calculated t test values in bold are significant).

Indexes	Barragem	Canoas	Juramento
Shannon (H')	1.98	1.91	1.88
Simpson (1/D)	6.21	5.52	5.53
Evenness (H'/log S)	0.80	0.70	0.80
Species richness (N)	12	13	11
t test for H'			
Barragem x Canoas		**2.1**	
Canoas x Juramento			1.0
Barragem x Juramento		**2.8**	

Table V. Values of Jaccard similarity index between all sampled sites of Juramento reservoir area, from March 2002 to February 2003.

Sites	Similarity
Barragem/Canoas	0.625
Barragem/Juramento	0.708
Barragem/Jusante	0.576
Canoas/Juramento	0.478
Canoas/Jusante	0.364
Juramento/Jusante	0.469

gradient described by PCII from the lowest (BF02) toward the highest (JF03) conductivity value (Fig. 4).

Inexpressive correlations were obtained between CPI ($r = 0.005$; $p = 0.90$) and CPII ($r = 0.139$; $p = 0.67$) scores and the log-transformed CPUEn values for the fish samplings.

DISCUSSION

Just around 200 fish species from the SFR basin have been identified (Alves & Pompeu 2001). The number found in the present study (33) represents 16.5% of this total. The studied area is located near of this basin headwaters, so the captured species number correspond to what would be expected, since

this number tends to increase progressively towards the river mouth (Vannote *et al*. 1980). A similar pattern was also found by Araújo (1996) and Petry & Schulz (2001), among other. In a preliminary study, 15 fish species were registered for Juramento reservoir (Dabés *et al*. 2001). From these, only *Trachelyopterus galeatus* (Linnaeus, 1766) was not captured in the present work.

Comparing with other SFR reservoir, 73 species were reported for Três Marias (Minas Gerais) (Britski *et al*. 1986). Considering that this reservoir has a maximum flooded area of 1050 km^2 and Juramento only 7.63 km^2, the species number found for the latter is relatively high. The reduced anthropic impact suffered by this reservoir, which is located into a protected area, could explain this result.

Two species, *Geophagus brasiliensis* (Quoy & Gaimard, 1824) and *Callichthys callichthys* (Linnaeus, 1758), considered as being abundant and having broad distribution in Velhas River basin (Alves & Pompeu 2001), were not captured in the present work. On the other hand, in the time between the first and the last sampling, only other two species were added to cumulative curve, thus indicating a good estimate for the local species richness.

Characiformes represented 75.7 % of all collected species while 18.1% were Siluriformes. From all species described for the SFR basin, each of the two above orders was accounted for 46% (Sato & Godinho 1999). Higher characiforms ratios are typical of small reservoirs according to Araújo & Santos (2001). The characiform abundance could be due to fish composition changes along the years caused by Juramento River impoundment, since such actions cause deep changes in fish assemblages and directly influence species biological functions (Merona 1987). It is also important to notice the local absence of perciforms, which are common in many Brazilian reservoirs.

Only two species, *Hoplosternum littorale* (Hancock, 1828) and *Hoplias lacerdae* Ribeiro, 1908, would be introduced in Juramento based on the findings of Ribeiro (1908 *apud* Alves & Pompeu 2001) and Oliveira & Moraes Jr (1997). It is a relevant fact, considering that fish introductions, most of them with deleterious effects, have been registered for other Brazilian reservoirs (Castro & Arcifa 1987, Alves & Vono 1997, Alves & Pompeu 2001). Exotic piscivorous species might radically change the fish communities structure in reservoirs as stated by Sunaga & Verani (1997) and Santos & Formagio (2000). In Juramento this is a real threat, since 'catch-and-pay' fish farms, one of the most important sources of fish introductions, are common in the region.

Significant higher captures in number were found only for CPUEn values at Canoas station, in the reservoir transition region. Normally, the transition region is the most fertile local, with higher ratios of primary productivity, density of fishes and light penetration (Thornton *et al*. 1990). In some situations, it also shows the greatest species diversity (Benedito-Cecilio *et al*. 1997).

The dominance of *S. brandtii* reflects a common pattern observed in Brazilian reservoirs. Several 'piranha' and 'pirambeba' species preferentially inhabit lentic environments, a fact that could indicate the species colonization success as a consequence of habitat changes (Agostinho & Júlio Jr 2002). The 'pirambebas' are responsible for an important amount of fish biomass found in oxbow lakes of the SFR (Braga 1964 *apud* Pompeu 1999). Eleven fish species were identified in the stomach content of *S. brandtii* according to Pompeu (1999). Eight of them were found in the Juramento reservoir and 5 were included between the most captured ones. This fact could explain the successful settlement observed for *S. brandtii* in Juramento reservoir.

Of the 23 species collected upstream of the dam, 13 were considered constant. This higher ratio could be due to the reservoir age (23 years), and indicates that the current ichthyofauna is formed mainly by well-succeed colonizers species.

Four of the 11 accidental species found at Jusante station are considered migratory or reophylic ones: *Hypostomus macrops* (Eigenmann & Eigenmann, 1888), *Rhinelepis aspera* Spix & Agassiz, 1829, *Salminus brasiliensis* (Cuvier, 1816) and *Brycon orthotaenia* Gunther, 1864. This fact suggests that the impoundment precluded these species, which, excluding *B. orthotaenia*, were captured in this station only during the reproductive period, between November and February. On the other hand, *Prochilodus argenteus* Agassiz, 1829 was constant downstream and absent upstream. This species has also been registered as the most abundant downstream of Três Marias reservoir (Sato *et al*. 2003).

Considering only the quantitative samplings, the species richness did not changes strongly between stations. This fact is possibly due to the small reservoir area (7.63 km^2), that hinders an effective species richness differentiation between its regions.

No relevant differences were found for evenness and diversity between Canoas and Juramento stations, independently of the index used, which highlights the reservoir homogeneity in that areas. The higher diversity detected in the lentic region by the Shannon index reflects a slightly more proportional species abundance in that local. In fact the 4 most abundant species from each station were accounted for 70% of the total CPUEn at Barragem and 82% at Canoas and Juramento.

In this respect, the literature seems not to indicate a clear pattern concerning to differences in diversity between reservoir zones. Thus, few changes in the diversity were found between the lentic environment, the transition region and a tributary of Barra Bonita reservoir (São Paulo) (Castro 1997), suggesting low variability for the sampled sites. However, higher diversity values were registered for the lotic region of Segredo reservoir (Paraná) (Agostinho *et al*. 1997).

Lower similarity values were found when comparing upstream with downstream stations, reflecting the fact that 10 species were found exclusively at Jusante. From these, six were migratory or reophylic species, indicating that the dam is acting as a barrier for them. Possibly, these species used to spread across the former river area, disappearing after the reservoir formation.

From the species captured upstream, only *Prochilodus costatus* Valenciennes, 1850 has a migratory reproductive behaviour, whereas *Hypostomus commersonii* Valenciennes, 1836

is typical of lotic environments. *P. costatus* populations have dramatically decreased at Três Marias and Sobradinho reservoirs since their formation (Sato & Godinho 2003). The impact of river damming over the great migratory fish acts mainly on their reproductive success (Agostinho *et al.* 1992). Thus, it could be supposed that reproduction and recruitment of *P. costatus* are taking place in the remaining 46 km upstream of the reservoir. This hypothesis is reinforced since the reservoir was formed 23 years ago, and that there is no official record about reintroduction of any species in that region. Few reophylic species were also described at Lajes reservoir (Rio de Janeiro) (Araújo & Santos 2001).

It has been mentioned that riverine species are typically abundant in the upper basin regions and in recently created reservoirs (Irz *et al.* 2002). Despite not being a recent reservoir, Juramento is located at the upper portion of the Verde Grande River basin, a fact that could explain the low number of reophylic species captured in it.

In the present study, log-transformed values of CPUEn were not significantly correlated with the PCI and PCII obtained from limnological variables, even so these components are related to these variables independent of the amount of fishes captured in each station and bimestre.

Significant correlations between ichthyofauna abundance and variables such as pH, dissolved oxygen and temperature were not found at oxbow lakes of Araguaia river (Tejerina-Garro *et al.* 1998), as observed in the present study. However, higher fish captures were correlated with higher conductivities and temperatures and lower values of dissolved oxygen at Segredo reservoir (Bini *et al.* 1997).

Old reservoirs, like Juramento, have already been passed through the early unbalanced situation, thus being reasonable to suppose that their fish fauna are less affected by changes in the environmental variables as that ones measured in this work. In that case, changes in abundance would be probably more related to other determining factors such as competition, predation and food availability.

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