Availability of sedimentary organic matter for benthic fishes of the upper Paraná river floodplain

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ABSTRACT. This work aims to investigate the hypothesis that sedimentary organic matter presents concentration variations in accordance to the size of sediment particles and to proximity with the river's margin. This organic matter is known as a feeding source for benthonic fishes. Sampling of the sediment was carried out in dry and rainy periods, at three Paraná River floodplain subsystems. Three sampling points were established: right margin, center and left margin. The samples (n=88) were submitted to granulometric fractionation (< 70μm; between 70 and 200μm; > 200μm). Low variability in organic matter concentration was observed for samples from the center of the subsystems. Particles, smaller than 70μm, had high variability in organic matter concentration. The rainy period was shown to affect concentration of organic matter adhered to the sediment fractions in transversal section at the sampled environments. With support of literature, the experiment lead to the conclusion that fish species which ingest particles of detritus < 70μm obtain more organic matter of sediment.

Key words: floodplain, Paraná River, sediment, organic matter.

RESUMO. Disponibilidade de matéria orgânica sedimentar para peixes benticos da planície de inundação do rio Paraná. O presente trabalho teve por objetivo investigar a hipótese de que o material orgânico sedimentar, conhecida fonte de alimento para espécies de peixes exploradores de fundo, apresenta variações na concentração de acordo com o tamanho das partículas do sedimento e proximidade com a margem do rio. A obtenção das amostras de sedimento foi realizada no período de seca e de chuva em três subsistemas da planície de inundação do rio Paraná, sendo estabelecidos três pontos de coleta: margem direita, centro e margem esquerda. As amostras (n=88) foram submetidas ao fracionamento granulométrico (< 70μm; entre 70 e 200μm; > 200μm). Observou-se menor variabilidade na concentração de matéria orgânica para as amostras do centro e maior para partículas menores que 70μm. Identificou-se o efeito do período de chuvas sobre a concentração de matéria orgânica aderida as frações de sedimento das secções transversais e nos ambientes amostrados. Concluiu-se, com base na literatura, que as espécies de peixes que ingerem detrito com partículas < 70μm, obtêm mais matéria orgânica do sedimento.

Palavras-chave: planície de inundação, rio Paraná, sedimento, matéria orgânica.

Introduction

Fish species described for the Paraná River floodplain include benthophagues, detritivores and iliophagues, that feed directly on organic matter contained in sediment (Agostinho *et al*., 1997). They are more than 47% of the total fish species sampled in that ecosystem (Agostinho *et al*., 1997). The percentage for the Amazon Basin is about 30% (Araújo-Lima *et al*., 1986).

The detritus from sediment is the most important energy source to the food chain in flood areas (Welcomme, 1985). The sediment is characterized as having low energy, protein content and low digestibility, being from 80% to 99% inorganic matter, which does not directly contribute to the nutrition of species (Bowen, 1987). The quantity of food required daily by bottom-dwelling fish to sustain themselves and develop is greater than the amount required by omnivores and carnivores (Brett, 1979; De Silva, 1985). Therefore, the ingestion of sediment raises the energy costs in digestion, due to the time needed for food processing (Power, 1984).

On the other hand, inorganic sediment aids the trituration of other food items (Payne, 1978). Thus, significant alterations on the sediment dynamics may be caused by these fish species during feeding. The trituration the sediment undergoes when it passes through the mechanical stomach favors the decrease in the particles' size and, according to Yamamoto and Lopez (1985), they return to the environment with a greater available surface area, increasing the adherence of organic matter to the sediment. Therefore, the animal species that use that resource constitute important links to one of the main routes in the energy flow and nutrient cycling, the detritivory chain of the ecosystem (Wetzel, 1975; Bowen, 1979; Vanni and Deruiter, 1996).

The main active channel of the floodplain ecosystem is the Paraná River, which is responsible for the drainage of that river's entire basin. The Baía and Ivinheima Rivers, the channels and countless lagoons complete the drainage network of the region (Souza Filho and Stevaux, 1997). The fluctuations of the hydrometric levels maintain river-floodplain connectivity and determine the seasonality of abiotic and biotic factors, fundamental to the various species of animal and plant organisms that use the floodplain as habitat to complete their life cycle (Thomaz *et al*., 1997).

Fugi *et al*. (2001) analyzed feeding strategies of five main species of benthic fish from Paraná River floodplain (*Prochilodus lineatus, Steindachnerina insculpta, Loricariichthys platymetopon, Trachydoras paraguayensis* and *Iheringichthys labrosus*), establishing particle size and organic matter content associated with the sediment present in the digestive tract for each of them. However, organic matter availability of the sediment before ingestion has not yet been analyzed, considering that the digestive process itself alters the particles' size. Thus, aiming to contribute to the understanding of the energy flow in detritivory chain of the Paraná River floodplain, this work investigated the hypothesis that sedimentary organic matter presents seasonal and spatial variations in its concentration, in accordance with the size of the sediment particles.

Material and methods

The sediment samples were carried out in 2001, during dry (August) and rainy (November) periods, in three subsystems of the Paraná River floodplain: Paraná, Baía and Ivinheima (22°40' to 22°50'S and 53°01' to 53°40'W) (Figure 1).

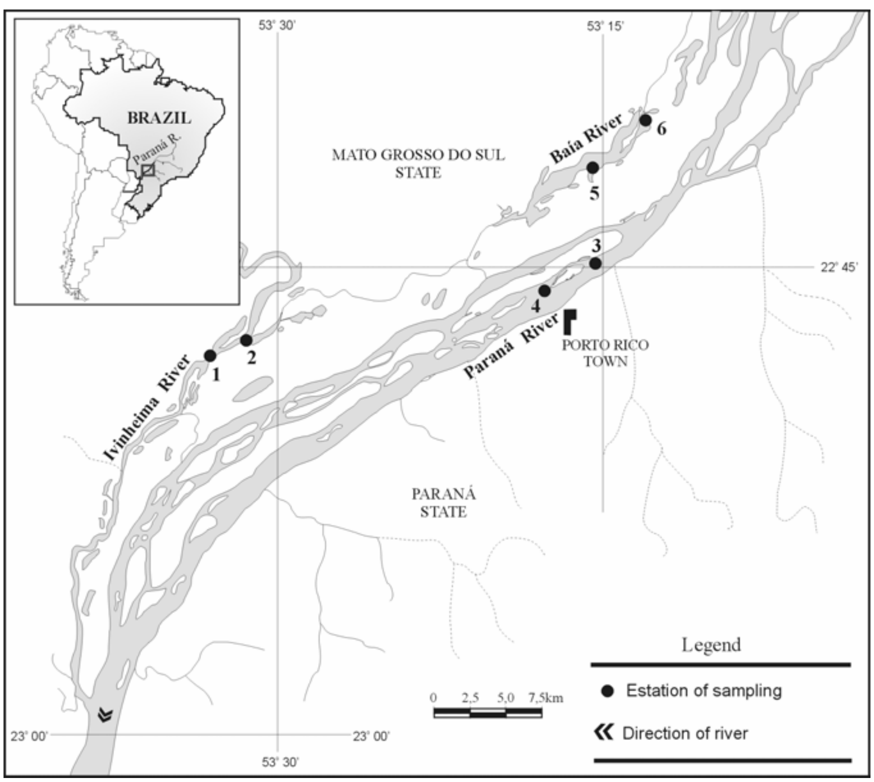

Figure 1. Sampling points: 1) Ivinheima River; 2) Finado Raimundo Lagoon; 3) Paraná River; 4) Pau Véio Ressaco; 5) Baía River; 6) Baía Channel.

Two sampling points were established in each of these subsystems, one in the main channel of the river and the other in an open lagoon or channel: Paraná River and Pau Véio Ressaco; Baía River and Baía Channel; Ivinheima River and Finado Raimundo Lagoon.

Three sampling points were established at each collection site: right margin, center and left margin. The samples (n=88) were taken at each collection point using a modified Petersen grab and submitted to granulometric fractionation. Three fractions were obtained: particles smaller than 70μm, between 70 and 200μm and larger than 200μm. The criterion used to the granulometric fractionation was established based on the results by Fugi *et al*. (2001).

The sediment fractions were dehydrated at 60ºC to a constant weight, obtaining the dry weight at each selected stratigraphic level.

The organic matter content of these samples was estimated, determining weight loss at 560ºC (Hakanson and Jansson, 1983) for 4 hours. After burning, the samples were cooled in a humidity-free environment for 2 hours and weighed. The organic matter loss through burning was calculated by weight difference (Table 1):

$OM = W_d - W_m/W_d \times 100$, where
OM = organic matter content percentage,
W_m = dry weight (inorganic residues) and
W_d = total dry weight (inorganic residues + organic matter).

Table 1. Relation of sampled data.

Station	Size(μm)	Point	O.M.(%)	Period
B.C.	< 70	Center	23,404	Rainy
B.C.	> 200	Center	0,302	Rainy
B.C.	70-200	Center	0,344	Rainy
B.C.	< 70	Center	18,447	Rainy
B.C.	> 200	Center	0,526	Rainy
B.C.	70-200	Center	1,184	Rainy
B.C.	< 70	Center	19,565	Rainy
B.C.	> 200	Center	1,231	Rainy
B.C.	70-200	Center	1,249	Rainy
B.C.	< 70	Center	27,273	Rainy
B.C.	> 200	Center	0,172	Rainy
B.C.	70-200	Center	3,318	Rainy
B.C.	< 70	Margin	22,472	Rainy
B.C.	> 200	Margin	29,812	Rainy
B.C.	70-200	Margin	24,013	Rainy
B.C.	< 70	Margin	21,262	Rainy
B.C.	> 200	Margin	14,994	Rainy
B.C.	70-200	Margin	19,571	Rainy
B.C.	< 70	Margin	20,718	Rainy
B.C.	> 200	Margin	33,708	Rainy
B.C.	70-200	Margin	21,019	Rainy
B.C.	< 70	Margin	19,756	Rainy
B.C.	> 200	Margin	33,537	Rainy
B.C.	70-200	Margin	22,193	Rainy
B.C.	< 70	Margin	14,352	Rainy
B.C.	> 200	Margin	12,339	Rainy
B.C.	70-200	Margin	4,190	Rainy

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Station	Size(μm)	Point	O.M.(%)	Period
B.C.	< 70	Margin	13,149	Rainy
B.C.	> 200	Margin	8,452	Rainy
B.C.	70-200	Margin	7,546	Rainy
B.C.	< 70	Margin	15,177	Rainy
B.C.	> 200	Margin	10,404	Rainy
B.C.	70-200	Margin	5,769	Rainy
B.C.	< 70	Margin	15,225	Rainy
B.C.	> 200	Margin	13,362	Rainy
B.C.	70-200	Margin	4,833	Rainy
F.R.L.	< 70	Center	15,262	Rainy
F.R.L.	> 200	Center	7,678	Rainy
F.R.L.	70-200	Center	5,679	Rainy
F.R.L.	< 70	Center	16,185	Rainy
F.R.L.	> 200	Center	6,018	Rainy
F.R.L.	70-200	Center	3,516	Rainy
F.R.L.	< 70	Center	16,637	Rainy
F.R.L.	> 200	Center	6,535	Rainy
F.R.L.	70-200	Center	3,686	Rainy
F.R.L.	< 70	Margin	12,833	Rainy
F.R.L.	> 200	Margin	3,890	Rainy
F.R.L.	70-200	Margin	8,333	Rainy
F.R.L.	< 70	Margin	13,433	Rainy
F.R.L.	> 200	Margin	0,809	Rainy
F.R.L.	70-200	Margin	1,716	Rainy
F.R.L.	< 70	Margin	14,788	Rainy
F.R.L.	> 200	Margin	0,838	Rainy
F.R.L.	70-200	Margin	8,120	Rainy
F.R.L.	< 70	Margin	21,242	Rainy
F.R.L.	> 200	Margin	51,077	Rainy
F.R.L.	70-200	Margin	18,318	Rainy
F.R.L.	< 70	Margin	22,339	Rainy
F.R.L.	> 200	Margin	11,828	Rainy
F.R.L.	70-200	Margin	9,202	Rainy
F.R.L.	< 70	Margin	20,520	Rainy
F.R.L.	> 200	Margin	47,531	Rainy
F.R.L.	70-200	Margin	13,225	Rainy
B.R.	< 70	Center	15,517	Rainy
B.R.	> 200	Center	2,830	Rainy
B.R.	70-200	Center	1,543	Rainy
B.R.	< 70	Center	15,636	Rainy
B.R.	> 200	Center	6,495	Rainy
B.R.	70-200	Center	1,717	Rainy
B.R.	< 70	Center	14,469	Rainy
B.R.	> 200	Center	1,609	Rainy
B.R.	70-200	Center	2,444	Rainy
B.R.	< 70	Center	16,061	Rainy
B.R.	> 200	Center	7,610	Rainy
B.R.	70-200	Center	8,228	Rainy
B.R.	< 70	Margin	12,202	Rainy
B.R.	> 200	Margin	8,753	Rainy
B.R.	70-200	Margin	2,055	Rainy
B.R.	< 70	Margin	14,286	Rainy
B.R.	> 200	Margin	19,964	Rainy
B.R.	70-200	Margin	1,781	Rainy
B.R.	< 70	Margin	15,642	Rainy
B.R.	> 200	Margin	35,374	Rainy
B.R.	70-200	Margin	1,730	Rainy
B.R.	< 70	Margin	15,780	Rainy
B.R.	> 200	Margin	10,311	Rainy
B.R.	70-200	Margin	2,028	Rainy
B.R.	< 70	Margin	13,051	Rainy
B.R.	> 200	Margin	6,848	Rainy
B.R.	70-200	Margin	3,701	Rainy
B.R.	< 70	Margin	12,144	Rainy
B.R.	> 200	Margin	6,382	Rainy
B.R.	70-200	Margin	2,890	Rainy
B.R.	< 70	Margin	12,074	Rainy
B.R.	> 200	Margin	6,037	Rainy
B.R.	70-200	Margin	2,034	Rainy
B.R.	< 70	Margin	12,380	Rainy
B.R.	> 200	Margin	8,152	Rainy
B.R.	70-200	Margin	2,319	Rainy
I.R.	> 200	Center	0,322	Rainy
I.R.	70-200	Center	0,309	Rainy

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Station	Size(μm)	Point	O.M.(%)	Period
I.R.	> 200	Center	0,629	Rainy
I.R.	70-200	Center	0,436	Rainy
I.R.	> 200	Center	0,460	Rainy
I.R.	70-200	Center	0,305	Rainy
I.R.	> 200	Center	0,489	Rainy
I.R.	70-200	Center	0,290	Rainy
I.R.	< 70	Margin	11,064	Rainy
I.R.	> 200	Margin	0,769	Rainy
I.R.	70-200	Margin	1,063	Rainy
I.R.	< 70	Margin	10,924	Rainy
I.R.	> 200	Margin	0,642	Rainy
I.R.	70-200	Margin	0,829	Rainy
I.R.	< 70	Margin	9,554	Rainy
I.R.	> 200	Margin	0,769	Rainy
I.R.	70-200	Margin	0,931	Rainy
I.R.	< 70	Margin	9,722	Rainy
I.R.	> 200	Margin	0,725	Rainy
I.R.	70-200	Margin	1,507	Rainy
I.R.	< 70	Margin	17,780	Rainy
I.R.	70-200	Margin	14,102	Rainy
I.R.	< 70	Margin	17,993	Rainy
I.R.	> 200	Margin	0,775	Rainy
I.R.	70-200	Margin	0,925	Rainy
I.R.	< 70	Margin	22,222	Rainy
I.R.	> 200	Margin	1,013	Rainy
I.R.	70-200	Margin	0,764	Rainy
I.R.	> 200	Margin	1,509	Rainy
I.R.	70-200	Margin	0,817	Rainy
I.R.	< 70	Margin	19,881	Rainy
I.R.	> 200	Margin	5,757	Rainy
I.R.	70-200	Margin	3,133	Rainy
P.R.	> 200	Center	0,234	Rainy
P.R.	> 200	Center	0,272	Rainy
P.R.	> 200	Center	0,145	Rainy
P.R.	> 200	Center	0,221	Rainy
P.R.	< 70	Margin	10,914	Rainy
P.R.	> 200	Margin	2,043	Rainy
P.R.	70-200	Margin	0,877	Rainy
P.R.	< 70	Margin	13,904	Rainy
P.R.	> 200	Margin	2,737	Rainy
P.R.	70-200	Margin	0,735	Rainy
P.R.	< 70	Margin	13,441	Rainy
P.R.	> 200	Margin	4,985	Rainy
P.R.	70-200	Margin	1,133	Rainy
P.R.	< 70	Margin	12,941	Rainy
P.R.	> 200	Margin	2,677	Rainy
P.R.	70-200	Margin	0,864	Rainy
P.R.	< 70	Margin	10,430	Rainy
P.R.	> 200	Margin	0,607	Rainy
P.R.	70-200	Margin	1,287	Rainy
P.R.	< 70	Margin	9,586	Rainy
P.R.	> 200	Margin	0,643	Rainy
P.R.	70-200	Margin	0,737	Rainy
P.R.	< 70	Margin	10,130	Rainy
P.R.	> 200	Margin	0,587	Rainy
P.R.	70-200	Margin	0,875	Rainy
P.R.	< 70	Margin	14,362	Rainy
P.R.	> 200	Margin	0,782	Rainy
P.R.	70-200	Margin	1,253	Rainy
P.V.R.	< 70	Center	10,826	Rainy
P.V.R.	70-200	Center	9,170	Rainy
P.V.R.	< 70	Center	12,282	Rainy
P.V.R.	> 200	Center	18,992	Rainy
P.V.R.	70-200	Center	6,686	Rainy
P.V.R.	< 70	Center	12,437	Rainy
P.V.R.	> 200	Center	16,198	Rainy
P.V.R.	70-200	Center	8,436	Rainy
P.V.R.	< 70	Center	11,250	Rainy
P.V.R.	> 200	Center	22,442	Rainy
P.V.R.	70-200	Center	8,267	Rainy
P.V.R.	< 70	Margin	12,724	Rainy
P.V.R.	> 200	Margin	22,564	Rainy
P.V.R.	70-200	Margin	5,701	Rainy
P.V.R.	< 70	Margin	12,694	Rainy

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Station	Size(μm)	Point	O.M.(%)	Period
P.V.R.	> 200	Margin	25,763	Rainy
P.V.R.	70-200	Margin	5,101	Rainy
P.V.R.	< 70	Margin	13,169	Rainy
P.V.R.	> 200	Margin	35,096	Rainy
P.V.R.	70-200	Margin	2,452	Rainy
P.V.R.	< 70	Margin	13,644	Rainy
P.V.R.	> 200	Margin	16,716	Rainy
P.V.R.	70-200	Margin	5,528	Rainy
P.V.R.	< 70	Margin	9,741	Rainy
P.V.R.	> 200	Margin	50,000	Rainy
P.V.R.	70-200	Margin	6,444	Rainy
P.V.R.	< 70	Margin	11,327	Rainy
P.V.R.	> 200	Margin	62,500	Rainy
P.V.R.	70-200	Margin	9,219	Rainy
P.V.R.	< 70	Margin	10,744	Rainy
P.V.R.	70-200	Margin	15,184	Rainy
P.V.R.	< 70	Margin	10,826	Rainy
P.V.R.	> 200	Margin	58,861	Rainy
P.V.R.	70-200	Margin	8,063	Rainy
B.C.	< 70	Center	18,493	Dry
B.C.	> 200	Center	0,991	Dry
B.C.	70-200	Center	2,729	Dry
B.C.	< 70	Margin	13,273	Dry
B.C.	> 200	Margin	31,615	Dry
B.C.	70-200	Margin	4,825	Dry
B.C.	< 70	Margin	21,495	Dry
B.C.	> 200	Margin	56,696	Dry
B.C.	70-200	Margin	18,859	Dry
F.R.L.	< 70	Center	16,628	Dry
F.R.L.	> 200	Center	5,989	Dry
F.R.L.	70-200	Center	5,763	Dry
F.R.L.	< 70	Margin	18,809	Dry
F.R.L.	> 200	Margin	28,043	Dry
F.R.L.	70-200	Margin	15,735	Dry
F.R.L.	< 70	Margin	19,095	Dry
F.R.L.	> 200	Margin	0,464	Dry
F.R.L.	70-200	Margin	0,421	Dry
B.R.	< 70	Center	15,314	Dry
B.R.	> 200	Center	0,557	Dry
B.R.	70-200	Center	0,612	Dry
B.R.	< 70	Margin	8,874	Dry
B.R.	> 200	Margin	7,804	Dry
B.R.	70-200	Margin	1,412	Dry
B.R.	< 70	Margin	10,132	Dry
B.R.	> 200	Margin	2,375	Dry
B.R.	70-200	Margin	2,103	Dry
I.R.	> 200	Center	0,348	Dry
I.R.	< 70	Margin	15,078	Dry
I.R.	> 200	Margin	20,216	Dry
I.R.	70-200	Margin	8,778	Dry
I.R.	< 70	Margin	10,251	Dry
I.R.	> 200	Margin	5,464	Dry
I.R.	70-200	Margin	2,997	Dry
P.R.	> 200	Center	0,247	Dry
P.R.	> 200	Margin	0,260	Dry
P.R.	> 200	Margin	0,237	Dry
P.V.R.	< 70	Center	11,434	Dry
P.V.R.	> 200	Center	12,638	Dry
P.V.R.	70-200	Center	6,028	Dry
P.V.R.	< 70	Margin	6,792	Dry
P.V.R.	> 200	Margin	16,115	Dry
P.V.R.	70-200	Margin	3,083	Dry
P.V.R.	< 70	Margin	10,330	Dry
P.V.R.	> 200	Margin	25,874	Dry
P.V.R.	70-200	Margin	4,419	Dry

B.C. = Channel Baía; F.R.L. = Finado Raimundo Lagoon; B.R.= Baía River; I.R. = Ivinheima River; P.R. = Paraná River; P.V.R. = Pau Veio Ressaco; O.M.= organic matter

The graphic and statistical analyses were conducted using STATISTICA 5.0™. The hypothesis of this work was statistically tested using ANOVA-factorial, considering organic matter a dependent variable and particle size, period and collection station (in this order) hierarchy factors. In addition, a one-way ANOVA was used to identify significant differences between the organic matter concentration of samples collected in dry and rainy periods in the center and margins of the sites. The Bonferroni correction was applied when more than one statistical test was carried out using the same data collection.

Results

During the dry period, differences were not verified in the proportion analysis of organic matter deposited in the sediments sampled in the marginal and central regions of the collection sites (one-way ANOVA: DF = 2; F = 1.17; p = 0.32), unlike the rainy period (one-way ANOVA: DF = 2; F = 3.41; p = 0. 03). During the two periods, the sample averages from the center were, in general, lower than those from one the margins (margin 1 and 2); whereas the averages obtained for the latter were similar and, therefore, analyzed together (Figure 2). In open lagoons, the central region samples were richer in organic matter. Considering each subsystems, open lagoons and channels presented the highest concentrations of organic matter, while the Paraná River exhibited the lowest.

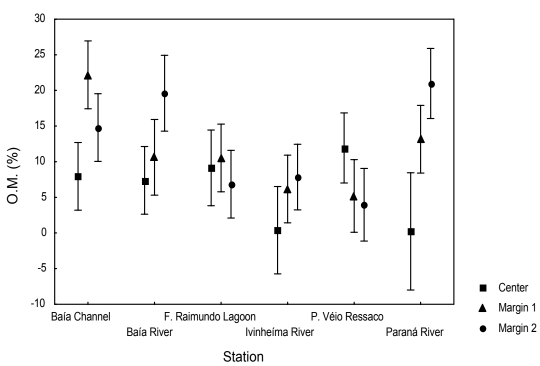

Figure 2. Average values and standard error of the organic matter (O.M.) concentration at the collection stations based on the collection points (center and margins).

Particles smaller than 70μm presented the highest organic matter concentration averages, followed by those larger than 200μm (Figure 3). It should be pointed out that sediment samples with particles larger than 200μm congregated, in addition to sediment, large pieces of organic detritus, composed of plants and animals retained in large-diameter meshes.

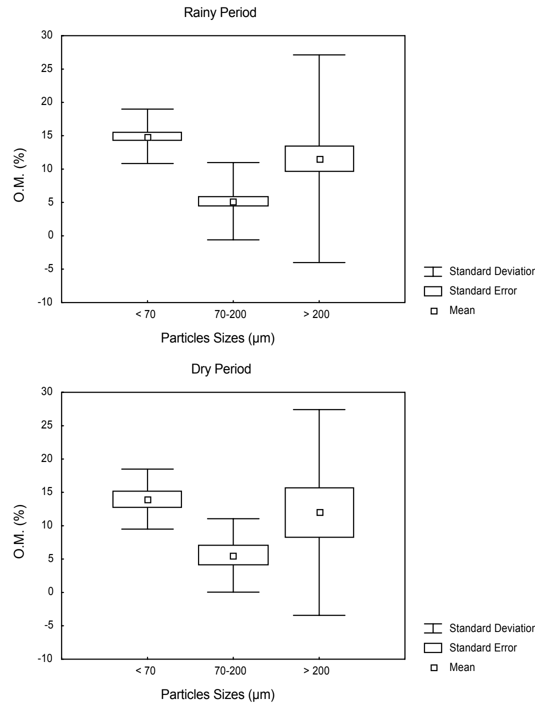

Figure 3. Average values, standard error and standard deviation of organic matter (O.M.) concentration, associated with particle size.

The results of ANOVA factorial indicated that significant differences were verified only during the rainy period (Table 2). This period affects the concentration of organic matter associated to different particles' size in the sampled stations and points.

Table 2. ANOVA factorial results for collecting samples of sediments on rainy and dry period of the upper Paraná River floodplain (DF = degrees of freedom; F = value of variance homogeneity test; p = probability; *= significant at 5%).

Rainy Period				Dry Period			
	DF	F	P		DF	F	P
Station (S)	5	1,018	0,457	**Station (S)**	5	1,604	0,39
Particle Size (PS)	2	1,523	0,327	**Particle Size (PS)**	2	1,141	0,483
Point (P)	1	0,668	0,489	**Point (P)**	1	0,432	0,566
S*PS	10	4,810	0,038*	**S*PS**	8	0,839	0,612
S*P	5	1,813	0,231	**S*P**	5	1,712	0,2655
PS*P	2	7,579	0,017*	**PS*P**	2	3,921	0,081
S*PS*P	7	1,542	0,157	**S*PS*P**	6	0,825	0,567

Discussion

In this study, the occurrence of higher organic matter concentrations in the marginal region, when compared to the central, is primarily explained by the proximity of the margins to the riparian vegetation. On floodplains, carbon is concentrated in the producers on the soil and in the sediment

(Junk, 1985). Thus, the organic matter proportion in the sediment is dependent on the predominance of primary producers in the marginal region (riparian vegetation and C_3 macrophytes). Due to the great quantity and variety of food resources in this region (originating from primary producers), there is a high density of invertebrates in the sediment (Takeda *et al*., 1997). Once dead, these organisms will compose the organic part of the sediment. The fact that water velocity is lower at the subsystem margins than in the central channel certainly eases the deposit of both plant and animal organic matter.

Significant values were verified only in rainy period for particle size and station, and sample point with particle size interactions. This is maybe a result of the water level effect on the Paraná River floodplain subsystems. A large quantity of food resources is carried to the interior of the water body in that period. On the other hand, in low level water period (dry season), the carrying of resources decreases, which leads to a lower growth rate in aquatic communities (especially fish) (Lowe-Mc Connell, 1964). This reveals changes in energy allocation, considering that rainy period characterize the beginning of the gonadal maturation process for many fish species from the Paraná River floodplain (Vazzoler *et al*., 1997).

Environmental conditions, in the occurrence of more lasting rains, are excellent for bottom-dweller fish species. During these prolonged pulses, the large flooded areas promote an enrichment of the organic matter deposited at the lagoons' bottoms, creating a availability of detritus and, consequently, of benthic organisms associated with it. This produces a large food supply for species of this trophic category, maximizing their permanence and development in these environments (Veríssimo, 1999).

In general, the lagoons presented higher organic matter concentrations than the rivers. According to Hahn *et al*. (1997), the floodplain is, on the whole, potentially used for feeding. This shows that, despite the differences in the biotopes (lagoons, channels and rivers), their assembleges are widely distributed and able to exploit the three environments simultaneously. However, for the five fish species studied by Fugi *et al*. (2001), the intensity of food capture is higher in the lagoons, when compared to channels and rivers.

Among the rivers sampled, Paraná River exhibited the lowest organic matter concentrations. This can be explained by its structure, which presents sandy sediment with few macroscopically visible organic deposits. In the main channel of the Paraná River, small vermiform animals live in the interstitial spaces of the sandy sediment. The benthic community is spatially and temporally influenced by the hydrological cycle, the form of communication with the river main channel and the substrate type. Larger organisms, often refuge builders, predominate in the mud, mainly in the lagoons and some stretches of the Baía River. These organisms may also be influenced by the organic matter concentration in the sediment, which is higher in muddy environments (Takeda *et al*., 1997). The Baía Channel stood out in the dry period by presenting the highest average of organic matter concentration (18,8%), whose muddy sediment had high organic deposits rates (remains of higher plants from the margins and aquatic macrophytes).

The sediment samples with particles smaller than 70μm and larger than 200μm presented the highest organic matter concentrations. In the latter case, large pieces of organic detritus, composed of plants and animals, were also retained in the large-diameter meshes, which may have influenced the results. In fact, sediment particles smaller than 70μm presented a greater surface for colonization by microorganisms and a greater area for dissolved nutrients adsorption.

However, Fugi *et al*. (2001) observed that the fish species that ingest the smallest sediment particles present the lowest concentrations of organic matter in the stomach. Iliophagous species like *P. lineatus* and *S. insculpta* possess selective ingestion for particle sizes of about 70μm, which may be related to their nutritional value. Thus, the digestibility factor must have influenced the results presented previously, where the spatial and seasonal factors of organic matter concentration in the species digestive tract were not considered. This study deals with spatial and seasonal effects on the organic matter concentration in the sediment. Thus, understanding the process occurring in the detritivory chain is fundamental to explain the phenomena responsible for maintenance of the higher trophic levels biomass. Detailed studies, taking into account not only detritivores available energy quantification, but also their origin and destination, are necessary. Only in this way is it possible to establish management and monitoring measures to sustain commercial exploitation of the fishing resources still present in the Paraná River floodplain ecosystem.

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