

Feeding of *Acestrorhynchus lacustris* (Characidae): A Post Impoundment Studies on Itaipu Reservoir, Upper Paraná River, PR

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ABSTRACT

With objective to know feeding spectrum of *Acestrorhynchus lacustris* (Reinhardt, 1874), a middle size predator in different places of influence area of Itaipu reservoir, stomach contents were analyzed. Samples were collected from March 1984 to February 1989 from Itaipu Reservoir and its adjacent areas. Its fed mainly on fishes, but it was an opportunistic (consumed 17 species of prey). Despite of the wide feeding spectrum, few preys were dominant in the diet, according to the different habitats sampled. As a result, it significant spatial differences in the diet was observed. Was observed through "Detrented Correspondence Analysis" (DCA) these were divided into three groups in relation with diet: preys from upstream, with higher scores; preys from the reservoir, with intermediate scores; and preys from a tributary with smaller scores. This discrimination may be a function of prey availability in each habitat. The mean size of preys consumed increased with the size of the predator, as well as the variance, i. e. the largest fish also consumed small preys.

Key words: Feeding, Predation, Characidae, Upper Paraná River, Itaipu Reservoir

INTRODUCTION

Acestrorhynchus lacustris (Reinhardt, 1874) is a characid of the subfamily Acestrorhynchinae, commonly known as the "peixe cachorro" or "bicuda". It is a medium-sized fish, and in the region of the Itaipu Reservoir is considered a fourth-class fish, of little commercial value. It is occasionally recorded in the commercial fishery. In experimental fishing it has been rarely caught in the riverine region, but more often in the lacustrine region. In spite of the low commercial value, the role of *A. lacustris* in the food chain must be fundamental. Besides serving as food for the large predators, it is a known piscivore which must act to control the fodder species, which become very abundant in the first years of formation of a reservoir (Agostinho *et al.*, 1992). Fish with this type of feeding habit increase the stability of an ecosystem, since they regulate the abundance of prey species (Nikolsky, 1963; Popova, 1978). Studies of trophic ecology serve to support these suppositions, since the food spectra of fishes

reflect the role of each in the ecosystem. Studies on the feeding of *A. lacustris* are limited to those of Catella & Torres (1984) in Três Marias Reservoir, State of Minas Gerais; Mesquiatti (1995) in an oxbow lake of the Mogi-Guaçu River, State of São Paulo; and Almeida *et al.* (1997) in the floodplain of the Upper Paraná River, State of Paraná. Trophic studies of large ichthyofaunistic communities have made brief reference to this species or others of the same genus (Barthem, 1987; Meschiatti, 1995; Benneman, 1996; Resende *et al.*, 1996; Hahn *et al.*, 1997). This paper describes the diet of *A. lacustris* in the area influenced by Itaipu Reservoir, the spacial and annual variations of the diet, its degree of overlap and the relationships between predator and prey sizes.

MATERIALS AND METHODS

The samples were taken in the Paraná River basin, in the area influenced by Itaipu Reservoir (Fig. 1).

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The collection points included the reservoir (Guaira, Santa Helena, and Foz a tributary (the São Francisco Falso River), and upstream (the Iguatemi and Piquiri Rivers). Itaipu Reservoir was closed in 1982, and collections of fish were begun in 1984. Collections were made monthly from March 1984 through February 1985, and bimonthly from March 1985 through February 1989. In the present study, because of the absence of this species from catches during certain periods and the common occurrence of specimens with empty stomachs, more detailed analysis was not possible.

The fish were caught with stationary nets of different mesh sizes (3.0 to 16.0 cm between adjacent knots). After the specimens were captured and measured, the stomachs were removed and preserved in 4% formol. This stomachs were analyzed after each sample.

The gastric contents were analyzed by the occurrence and gravimetric methods, combined in the Alimentary Index modified (IAi) (Kawakami & Vazzoler, 1980). The similarity between the diet of the prey organisms was evaluated by Spearman's Correlation. Bonferroni's Correlation ($= 0.05/\text{number of tests}$) was used to evaluate the significance of the tests (Cristensen, 1996).

The combination of environment with season of collection was ordinated according to the food items consumed by *A. lacustris*, using Detrended Correspondence Analysis (DCA; Jongman *et al.*, 1995). The data for diet obtained by application of the IAi were used in this ordination.

The relationship between the size of the predator (*A. lacustris*) and the prey was established based on the standard lengths of both in centimeters.

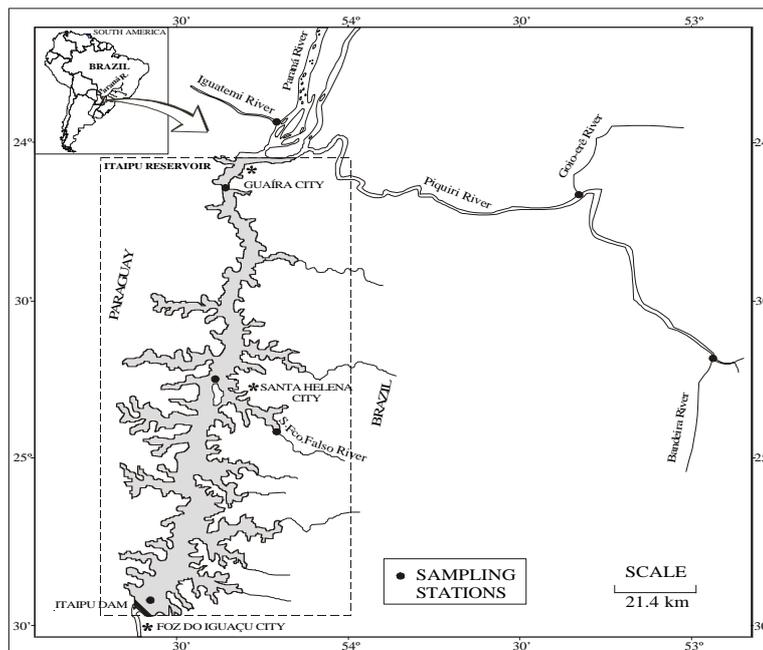


Figure 1 - Geographic location of the area studied. Square indicates the area influenced by Itaipu Reservoir.

RESULTS

Analysis of the stomach contents of 83 adult individuals of the *A. lacustris* (Ls 10.7-29.7 cm) showed that this species fed exclusively on fish in the different habitats sampled. The food spectrum showed 17 species of prey fish, and others which could not be identified because of the advanced state of digestion (Table 1). In spite of the large variety of prey recorded, few species stood out in

each environment. The alimentary index showed that in the reservoir these species were prominent, in decreasing order of importance: *Astyanax bimaculatus* (35.6%), *Crenicichla niederleinii* (29.4%), and *Steindachnerina insculpta* (20.6%). In the tributaries, the most important prey species were *Crenicichla niederleinii* (35.8%), *Astyanax bimaculatus* (27.1%), and *Prochilodus lineatus* (22.7%). Upstream, *Bryconamericus stramineus* composed practically the entire diet (73.8%)

(Table I). Although several prey species were common in all three environments, there was no significant correlation indicating differences in the diet of the fish between the reservoir and tributary ($S = 0.1756$; $p = 0.4721$), reservoir and upstream

($S = 0.1154$; $p = 0.6380$), and tributary and upstream ($S = 0.1451$; $p = 0.5533$). However, we noted the small number of stomachs examined from fish caught in the tributary.

Table 1 - Relative frequency of occurrence (% O), weight (% W), and Alimentary Index (% IAi) for prey items of *Acestrorhynchus lacustris* in the different environments sampled.

Preys	Reservoir (n=36)			Tributary (n=7)			Upstream (n=40)		
	% O	% P	% IAi	% O	% P	% IAi	% O	% P	% IAi
<i>Apareiodon affinis</i>							2,44	0,43	0,07
<i>Astyanax bimaculatus</i>	13,51	35,84	35,63	14,29	35,62	27,13	4,88	8,98	2,72
<i>Astyanax fasciatus</i>				14,29	7,85	5,98	4,88	10,18	3,08
<i>Bryconamericus stramineus</i>							46,34	25,68	73,85
<i>Characidium</i> sp	2,71	0,19	0,04						
<i>Crenicichla lepidota</i>				14,29	11,03	8,4			
<i>Crenicichla niederleinii</i>	16,22	24,66	29,4	42,85	15,67	35,78	9,76	15,91	9,64
<i>Crenicichla haroldoi</i>							2,44	2,79	0,42
<i>Hyphessobrycon callistus</i>	13,51	1,31	1,3				2,44	0,74	0,11
<i>Leporinus ambliorhynchus</i>							2,44	8,32	1,26
<i>Miloplus</i> sp							2,44	2,85	0,42
<i>Moenkhausia intermedia</i>	21,62	3,63	5,77				7,31	2,91	1,32
<i>Piabina argentea</i>							7,31	12,91	5,86
<i>Prochilodus lineatus</i>				14,29	29,83	22,71			
<i>Roebooides paranensis</i>	13,51	6,92	6,88				2,44	0,89	0,13
<i>Serrasalmus marginatus</i>	2,71	0,28	0,05						
<i>Steindachnerina insculpta</i>	10,81	25,94	20,64				2,44	6,65	1,01
Peixe não identificado	5,42	1,23	0,24						
Tetragonopterinae							2,44	0,76	0,11

Principal preys

The results of the spatio-temporal ordination of the diet by correspondence analysis are shown in Fig. 2. The first axis (eigenvalue = 0.93) grouped the majority of localities and years in the lowest scores, and segregated the diet of *A. lacustris* in the reservoir/1996, as a result of high consumption of *Hyphessobrycon callistus* and *Moenkhausia intermedia*. The second axis (eigenvalue = 0.64) was the most representative. This axis separated the upstream with higher values, mainly because of the ingestion of *B. stramineus*; the reservoir with intermediate values, represented mainly by the prey species *A. bimaculatus* and *C. niederleinii*; and tributaries with the lowest values,

because of ingestion of *C. niederleinii* and *P. lineatus*. This analysis, however, showed that diet is differentiated mainly as a function of environment, not of year of collection.

The relationship between the length of the predator is showed in figure 3 and its prey [$y = -964683(\pm 0,678283) + 0,346256(\pm 0,040270)$]. Note that as *A. lacustris* grows, the prey taken increase in size ($r^2 0,4589$). Nevertheless, we observe from the dietary composition that even specimens approximately 20.0 cm long consume small-sized prey.

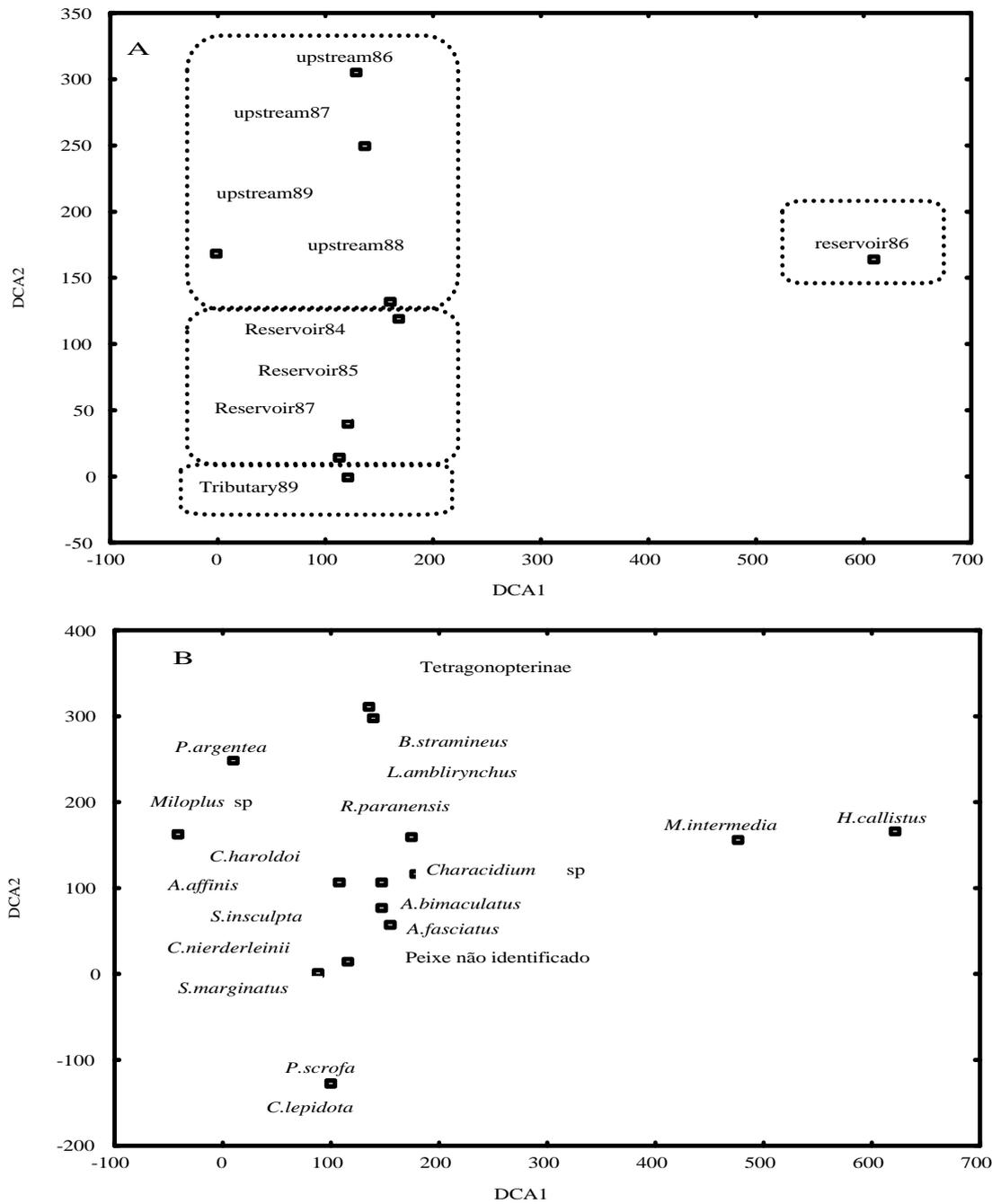


Figure 2 - Graphical representation of the space defined by the first two DCA axes, based on the IAI data for *Acestrorhynchus lacustris*. A, ordination of the localities and seasons. B, ordination of prey items.

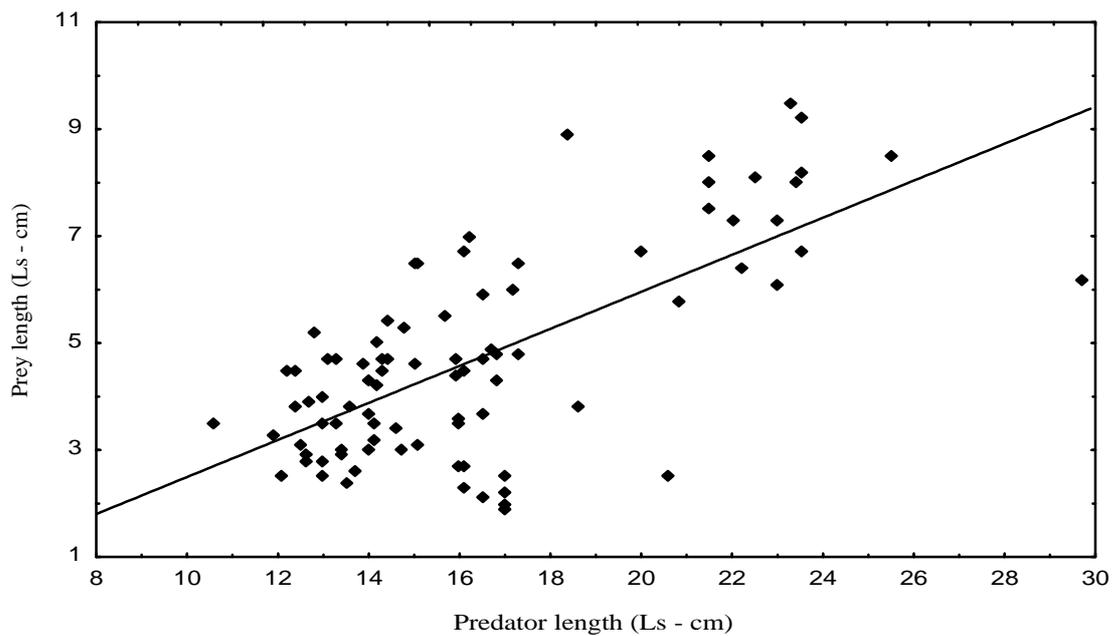


Figure 3 - Relationship between the sizes of the predator, *Acestrorhynchus lacustris*, and its prey species.

DISCUSSION

In the Itaipu Reservoir region, specimens of *A. lacustris* over 10.0 cm had an exclusively piscivorous diet. Our studies corroborated those of Benneman *et al.*, (1996), who found only fish in the stomach of this species in the Tibagi River, State of Paraná. In other studies of its diet, insects and plants were also recorded, though only as occasional food (Catella & Torres, 1984; Mesquiatti, 1995; Almeida *et al.*, 1997; Benneman, 1996). It is obvious, however, that the wide spectrum of prey fish characterizes it as an opportunistic species (Gerking, 1994). In the Pantanal of the Mato Grosso, another species of this genus, *Acestrorhynchus pantaneiro*, although it consumed fish, also consumed practically an equal proportion of shrimp (Resende, 1996). The main prey species composing the diet in the three environments studied were small fodder species, which frequently inhabited the littoral zones of waterbodies (Delariva *et al.*, 1994; Benneman, 1996). *Acestrorhynchus lacustris* must follow the movements of these prey species, since its canine and conical teeth and prognathous mouth facilitate predation at the water surface. Nico & Taphorn (1985) referred to *Acestrorhynchus microlepis* as an active species which inhabits nearshore areas in the llanos of Venezuela. The composition of food showed no correlation between the environment,

doubtless as a result of the abundance of certain prey species in the localities sampled. Wootton (1990) referred to fish as good samplers and emphasized that the stomach contents reflect what is available in the environment. Hahn *et al.* (1997) verified this fact for the piscivorous species *Plagioscion squamosissimus* in Itaipu Reservoir, where it feeds intensively on two species of fish which became very abundant soon after closure of the reservoir. On the Upper Paraná River floodplain, Almeida *et al.* (1997) established that five species of piscivorous fish, including *A. lacustris*, showed themselves to be opportunists in relation to prey abundance, taking advantage of the seasonal offerings of the environment. According to Graham & Vrijenhoek (1988), ordination of food items along the DCA axes shows a distribution of the prey and of the behavior of the predators. In the present study, three spatial groups were formed as a function of food type: upstream, reservoir, and tributaries. However, the annual data (season in which the predator was collected) did not influence the analysis, since the diversity and abundance of these fodder species varied little during those years (Benedito-Cecílio, 1994). In view of this, we could infer that the characteristics of the environments studied, mainly those of the reservoir, did not undergo relevant changes. Prey size is a limiting factor for the predator, because of the capacity of

the mouth opening and often the size of the stomach. Several investigators have observed that piscivores ingest prey smaller than one-third of their own length (Goulding *et al.*, 1988; Machado-Allison, 1990; Almeida *et al.*, 1997). However, this is not a rule, since the traíra *Hoplias malabaricus*, as reported in a number of studies, can ingest fish nearly its own length (Barthem, 1987; Winemiller, 1989; Almeida, 1994; Loureiro & Hahn, 1996). In the present study, the largest prey recorded was a specimen of *Crenicichla niederleini* 9.5 cm long, eaten by an individual 23.3 cm long. However, most prey individuals were between 3.0 and 5.0 cm. These data corroborate those of Catella & Torres (1984) in Três Marias Reservoir and of Almeida *et al.* (1997) on the Parana River floodplain, for the same species.

CONCLUSIONS

At present, *A. lacustris* is not being caught in the area of the Itaipu Reservoir, either by professional fishermen or in experimental fishing. At the same time *Hoplias malabaricus*, *Raphiodon vulpinus*, and the introduced species *Cichla ocellaris* have substantially increased their populations. It is probable that because of intense competition from these piscivores together with other factors that have not been investigated, *A. lacustris* has become drastically less abundant in this environment.

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RESUMO

Com o objetivo de conhecer o espectro alimentar de *Acestrorhynchus lacustris* (Reinhardt, 1874), um predador de médio porte, em diferentes locais da área de influência do reservatório de Itaipu, foram analisados conteúdos estomacais coletados no período de março/84 a fevereiro/89. Os dados

evidenciaram tratar-se de uma espécie exclusivamente piscívora, porém oportunista, visto que consumiu 17 espécies de peixes-presa. Apesar do amplo espectro alimentar, poucas presas se destacaram nos distintos ambientes amostrados, resultando em diferenças significativas entre suas dietas. A análise de correspondência (DCA) discriminou espacialmente três grupos; montante, com maiores escores; reservatório, com valores intermediários e tributário com menores valores, provavelmente em função dos tipos de presas disponíveis em cada ambiente. O tamanho das presas ingeridas aumenta com o crescimento do predador, porém os maiores exemplares não descartam peixes de pequeno porte de sua dieta.

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