

Diet of *Iheringichthys labrosus* (Pimelodidae, Siluriformes) in the Itaipu Reservoir, Paraná River, Brazil-Paraguay

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ABSTRACT

Iheringichthys labrosus is a secondary commercial fish species in the Itaipu Reservoir, but it is important in other reservoirs of the basin. However, little information exists about this species in the literature. The purpose of this study was to describe the diet of this species in the Itaipu Reservoir. Stomachs of 306 fishes were analyzed, collected from October 1994 to September 1996 in the different zones of the reservoir (according to a longitudinal gradient). The reservoir was separated into riverine (upper reach), transitional (middle reach), and lacustrine (next to the dam) zones. Main items in the diet of *I. labrosus* were aquatic insects (mainly Chironomidae) and mollusks (mainly Bivalvia). Their presence in the diet did not vary according to zones. Also, there was little seasonal variation in the diet. This indicated a conservative diet that could be a result of the high abundance of the items in the reservoir, or restrictions imposed by its buccal and digestive apparatus.

Key words: Itaipu Reservoir, freshwater, fish, feeding, diet composition, benthophagous

INTRODUCTION

Reservoirs are complex systems that exhibit a range of ecological, economic and social interactions (Tundisi, 1996). In ecological terms, these systems, due to human interference, show combinations of riverine and lacustrine elements. Fish species composition depends on the fauna of the rivers where they were formed (Fernando & Holcák, 1991).

Iheringichthys labrosus is a secondary commercial fish species in the Itaipu Reservoir (FUEM/Itaipu Binacional, 1987). However, it is an important fish species in other reservoirs of the basin, especially Promissão and Água Vermelha Reservoirs (Agostinho *et al.*, 1995; CESP, 1996). It is also an important sport fish in the sand beaches ("mandizeiros") fishery along the upper Paraná

River channel and main tributaries. With the end of the trophic upsurge period in the Itaipu Reservoir (Agostinho *et al.*, 1999 a and b), secondary species may become important resources for the commercial fishery. *I. labrosus* seems to be one of these species, and it has not been well studied in the basin (Kara, 1991).

Studies on feeding of this species were conducted by Fugi (1993) and Fugi *et al.* (1996) in the floodplain of upper Paraná River, and characterized the species as benthophagous, feeding mainly at dawn and during daytime hours. However, there is few information on the feeding ecology of *I. labrosus* in the Itaipu Reservoir, in despite of its increasing importance on the commercial fishery. Thus, the purpose of this study is to analyze the diet of *I. labrosus* in the Itaipu Reservoir.

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STUDY AREA

Itaipu Reservoir (24°05'-25°33'S, 54°00'-54°37'W) is a 1350 km² hydropower reservoir. It was impounded in 1982 on the Paraná River along the Brazil-Paraguay border (Figure 1). The reservoir has an average depth of 21 m and a maximum depth of 170 m. Retention time is about 40 d and discharge about 8,200 m³ s⁻¹. Total phosphorus concentration averages 22 mg m⁻³ and chlorophyll *a* 3.6 mg m⁻³. This corresponds to trophic state indexes (Carlson, 1977) of 49 and 43, respectively, suggesting mesotrophic conditions. The reservoir is 150 Km long and upstream is a 230 Km long, free-flowing stretch of Paraná River. This reservoir presents a well-defined longitudinal gradient, with three different zones: riverine, transitional and lacustrine (Thornton, 1990; Agostinho *et al.*, 1995).



Figure 1 - Location of the Itaipu Reservoir on the Paraná River basin along the Brazil-Paraguay border.

MATERIALS AND METHODS

Fishes were collected in the different zones of the Itaipu Reservoir from October 1994 to September 1996. Stomachs of 306 fishes (standard length: 14.3-32.9 cm) were extracted and fixed in 4% formalin, then preserved in 70% alcohol. Stomach contents were identified taxonomically to the lowest possible level and expressed as % of occurrence and % of volume (Hynes, 1950; Hyslop, 1980). The volume of larger items was determined through displacement of water in a graduated cylinder. Small items were separated in a Petri dish, then squashed on graph paper to uniform depth of 1 mm to determine their volume (Hellawell & Abel, 1971). It was assumed that 1mm³ was equal to 0.001ml. The results were

combined into an index of food importance (IA_i; Kawakami & Vazzoler, 1980) as:

$$IA_i = \frac{O_i V_i}{\sum_{i=1}^{i=n} O V} * 100$$

Where: O=% occurrence; V=% volume.

The items were grouped according to the highest taxonomic group to assess the main food resources available for *I. labrosus*. After the diet was described, we continued our analysis with the items that contributed at least 85% of the IA_i. These items were Diptera, Trichoptera, Bivalvia, and Ostracoda. The remaining items were classified as "others". Items were classified as principal (IA_i ≥ 50%), secondary (25% ≤ IA_i < 50%), and accessory (IA_i < 25%) (Rosecchi & Nouaze, 1987).

RESULTS

Food items and guild: *I. labrosus* was identified as benthophagous, feeding basically on benthic aquatic insects (64.7%), and mollusks (26.1%) (Figure 2A). The most common group of insects was immature forms of Diptera (Chironomidae). Bivalvia was the most consumed among the mollusks (Figure 2B).

The diet: The diet composition of *I. labrosus* in the riverine, transitional, and lacustrine zones showed few variations in the study period (Figure 3). In the riverine zone, Bivalvia predominated in the diet in 1995, and Diptera in 1996. In the transitional zone, Diptera dominated during the study period. Both Diptera and Bivalvia were abundant in the diet in the lacustrine zone, except in 1996, when Diptera predominated as principal prey.

Seasonal variations in the diet of *I. labrosus* were not accentuated during the study period (Figure 4). Benthic organisms can present variations related mainly to their biological cycles in the different zones of the reservoir. Diptera predominated in the diet in the spring and summer in 1994. Bivalvia was the most consumed food in the fall of 1995 and Diptera during summer. Diptera was the predominant food resource in 1996, except in the fall, when Bivalvia was predominant in the diet. Other items, such as crustaceans (Conchostraca) were important in the spring of 1995, and in the summer of 1996.

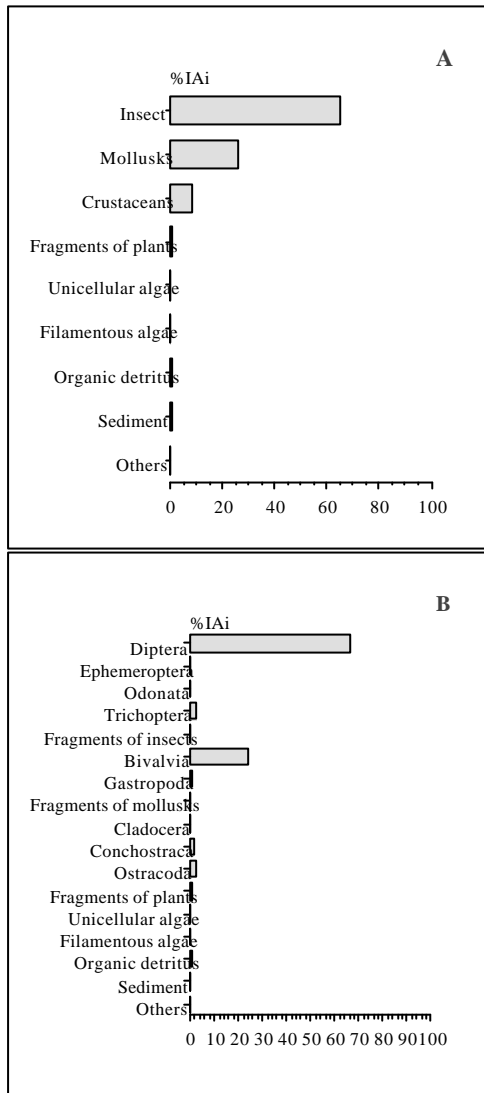


Figure 2 - Importance of the items (%IAi) in the diet of *I. labrosus* in the Itaipu Reservoir (A-Food items grouped; B-Food items not grouped).

DISCUSSION

Iheringichthys labrosus is a benthophagous in the Itaipu Reservoir. This was verified by prior studies in the Itaipu Reservoir (FUEM/Itaipu Binacional, 1989), upper Paraná River basin (Fugi *et al.*, 1996; Agostinho *et al.*, 1997 a), Corumbá Reservoir (Agostinho *et al.*, 1997 b), and Água Nanci Stream (Abes, 1998).

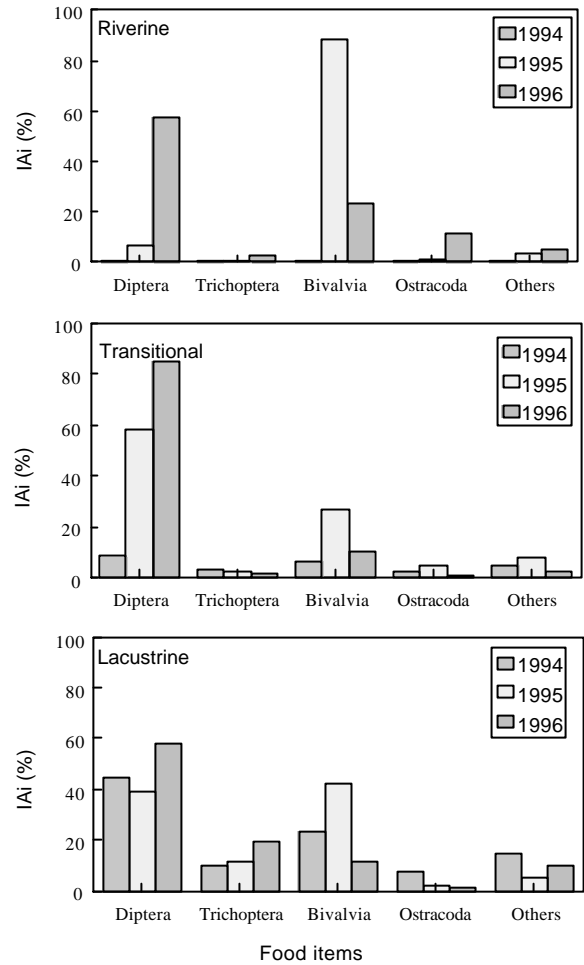


Figure 3 - Temporal (three years) and spatial (longitudinal gradient) variations in the diet of *I. labrosus* in the Itaipu Reservoir.

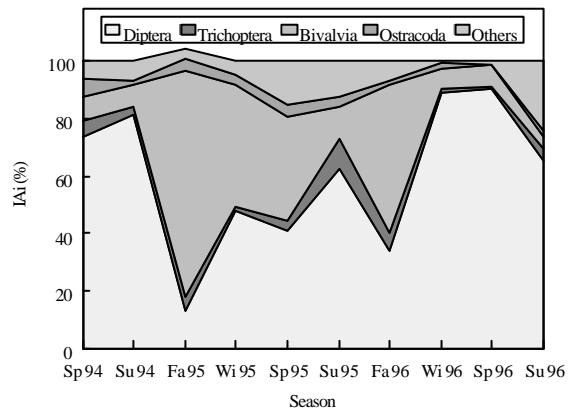


Figure 4: Seasonal variations in the food resources available for *I. labrosus* in the Itaipu Reservoir (Sp-spring; Su-summer; Fa-fall; Wi-winter; 94-1994; 95-1995; 96-1996).

The consistence of the diet in the different studies may result from the constraints of the buccal and digestive apparatuses. Fugi (1993) stated that the

morphology of the digestive system allowed one to characterize the species as a selector of organisms of the meso and macro benthos. Although little amount of sediment were ingested, *I. labrosus* exhibited a narrow, small mouth positioned subinferiorly, with thick lips and free superior margin. Within the buccal cavity, the species was equipped with well-developed plates of teeth distributed in the premaxillary and dentary. They were also found in the pharynx. These adaptations of the buccal apparatus has function of select preys on the bottom. The short distance among gill rakers indicated that food selection might occur. Similar morphology adaptations of benthic fishes were noted by Hynes (1970), Liem (1979) and Gerking (1994). The stomach was saclike, functioning for digestive purposes.

The huge amounts of chironomids in the diet of *I. labrosus* might reflect the abundance of this group in the reservoir. After 12 years of impoundment, the benthic community seemed to be well developed. Likely, this was a result of the great quantities of vegetation that were submerged during the filling phase, which created substrate for their development (Ploskey, 1985). Also, chironomids might be considered r-strategists, with high fecundity and haemoglobin to live in low concentrations of oxygen (Baxter, 1977). This indicated great potential for the colonization of aquatic systems.

I. labrosus had a well defined diet with no relevant variation along the year. Other studies identified some differences in the proportion of food items according to the zones of the reservoir and season of year (Fugi, 1993).

In tropical streams, the abundance of the benthic invertebrates varied among streams, habitats, and season (Angermeier & Karr, 1983). The relative abundance of drifting taxa and benthic invertebrates also showed variation among seasons in a temperate stream (Angermeier, 1982). However, other benthophagous species (callichthyids) showed little differences in the diet (aquatic insects and detritus) among seasons (Mol, 1995). This might be a result of the ample amounts of available benthic invertebrates. Hahn *et al.* (1991) and Fugi (1993) found similar results for another benthophagous species, *Trachydoras paraguayensis*, in the Itaipu Reservoir and floodplain of the upper Paraná River basin.

In conclusion, *I. labrosus* fed on a wide variety of aquatic invertebrates but all were benthic. This could be a result of food item abundance, or intake

constraints due to the morphology of buccal and digestive apparatuses.

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RESUMO

Iheringyichthys labrosus é uma espécie de importância secundária na pesca comercial realizada no reservatório de Itaipu, mas é importante em outros reservatórios localizados à montante. O objetivo desse trabalho foi descrever a dieta de *I. labrosus* no reservatório de Itaipu. Os conteúdos gástricos de 306 peixes foram analisados, coletados de outubro de 1994 a setembro de 1996, nas diferentes zonas do gradiente longitudinal do reservatório (fluvial, transição e lacustre). Os itens principais na dieta de *I. labrosus* foram os insetos aquáticos (Chironomidae) e moluscos (Bivalvia) e a dominância desses itens variou pouco durante o período estudado. Isso pode ser atribuído à elevada abundância dos itens preferenciais nas diferentes zonas, ou de restrições alimentares impostas pelas adaptações apresentadas na boca e aparelho digestório de *I. labrosus*.

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