

**FEEDING OF *HOLOSHETHES HETERODON* EIGENMANN
(TELEOSTEI, CHEIRODONTINAE) OF THE CAJURU RESERVOIR
(MINAS GERAIS, BRAZIL), IN RELATION TO THE VEGETAL
BIOMASS ON ITS DEPLETION ZONE**

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ABSTRACT. Stomach contents of *Holoshethes heterodon* Eigenmann, 1915 (Teleostei, Cheirodontinae), collected in the depletion zone of Cajuru reservoir when it was at its maximum water level in two stations with different vegetal densities, were studied in order to investigate the influence of the flooded vegetal biomass on the food quantity and quality ingested by fish. Eighteen individuals from each station were examined. The standard length was 1.53 ± 0.05 cm and 1.52 ± 0.05 cm, respectively at the lower biomass (8.19 kg dry weight/ha) and higher biomass (38.10 kg dry weight/ha) sampling stations. The stomach repletion Index (SRI) was applied for the quantitative analysis. The alimentary index (IAi) was used for the quali-quantitative analysis, with the volume of the items obtained through the points method. SRI did not show values significantly different between the two stations, $p \geq 0.05$, by applying the Mann-Whitney test. In both situations, *Cladocera* was the most important item. There were no correlation between the flooded vegetal biomass in the depletion zone and the intake of food by *H. heterodon*. However, as there were no empty stomachs, possibly even the lower vegetal biomass was enough to provide abundant feeding resources.

KEY WORDS. Fish feeding, reservoir, depletion zone, water level, vegetal biomass, *Holoshethes heterodon*.

Reservoirs of tropical regions are young lakes and dominate fresh-water bodies in several areas (FERNANDO 1994). In Brazil, and particularly in Minas Gerais State, the high number of dams, built for electric energy generation retains a significant portion of the superficial water volume (ELETROBRÁS 1990).

The construction of hydroelectric dams and the consequent formation of artificial lakes arouses great changes in the fish community structure. The migratory species, also called piracema species, cannot transpose the barrier to complete their reproductive cycle, becoming less abundant upstream and downstream from the barrier and, in several times, absent in reservoirs (AGOSTINHO *et al.* 1992). In these, the ichthyofauna becomes dominated by non-migrating species, of smaller size and low longevity (AGOSTINHO *et al.* 1992). The changes tend to grow worse in rivers with successive dams (GODINHO 1993).

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In reservoirs, the water level is strictly controlled according to the hydrologic cycle, periods of peak of electricity consumption and interactions with other reservoirs, making its oscillations generally regular along the year. Depending on the relief of the region, such fluctuations may flood and drain large areas, promoting the decomposition of the vegetal biomass present in the depletion zone and the carrying of substances to the water body (WETZEL 1990). In this process, the margins are exposed and flooded, the nutrients are oxidized and reduced and the community of plants has its diversity and density affected (COHEN & RADOMSKI 1993).

The greater is the flooded vegetal biomass, the greater will be the nutrients' income, the productivity of the reservoir and the offering of food to the ichthyofauna (BERNACSEK 1984). So, the effects of the flooded terrestrial vegetation on several trophic levels should be systematically surveyed.

Studies on the feeding habits of fish in reservoirs in relation to the conditions of the depletion zone, besides supplying data about the ecology of the species, may serve as subsidies for a better comprehension of the influence of the flooded vegetal biomass, helping in the adequate management of these water bodies.

The main purpose of this study was to verify the influence of flooded vegetal biomass in the ingestion of food by *Holoshesthes heterodon* Eigenmann, 1915 in two different stations of the Cajuru reservoir.

MATERIAL AND METHODS

Study area

Cajuru reservoir (Fig. 1) belongs to Companhia Energética de Minas Gerais (CEMIG) (Energetic Company of Minas Gerais) and was formed in 1959 by the damming of Pará river, a right side affluent of São Francisco river. It is located at Carmo do Cajuru, Divinópolis, and Cláudio counties. Its total floodable area is of 27 km² and the accumulated water volume is 192 x 10⁶ m³ at its maximum quota, which occurs when the water level reaches 753,0 m of altitude (MELLO 1978).

Species studied

The occurrence of *Holoshesthes heterodon* (Fig. 2) is mentioned for the São Francisco (BRITSKI *et al.* 1988), Paraná (UIEDA 1984; ANDRÉ 1987) and Paraguay (SCHINDLER 1939 *apud* ANDRÉ 1987; BERTONI 1939 *apud* ANDRÉ 1987) river basins.

According to ROCHE *et al.* (1993) *H. heterodon* is a zooplanktophagous visually oriented. They described the effects caused in the plankton community of the Lobo reservoir (SP) by its predation on microcrustaceans and *Chaoborus* Lichtenstein larvae. Due to its small size, *H. heterodon* is an important as a foraging item for piscivore species, such as piranhas (NORTHCOTE *et al.* 1986). In Cajuru reservoir littoral zone, *H. heterodon* is one of the most abundant and frequent species.

Methods

Three 70 m transects were demarcated parallel to the reservoir margins for the quantification of the vegetal biomass. Squares of 625 cm² were used to determine

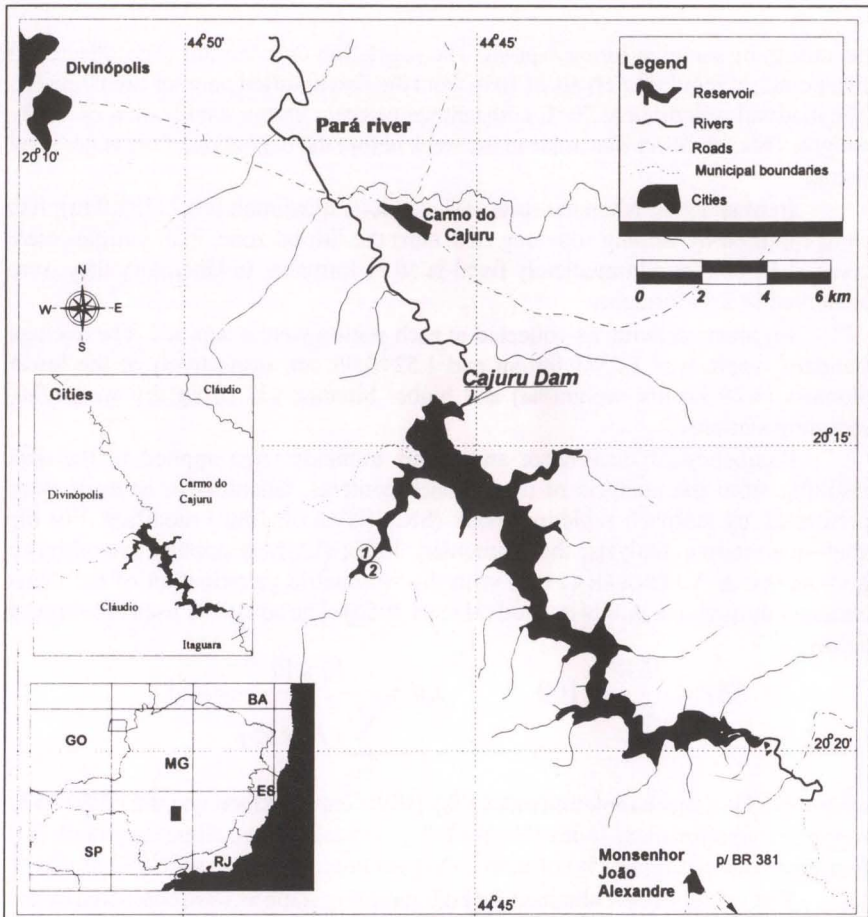


Fig. 1. Map of Cajuru reservoir, showing sampling stations.

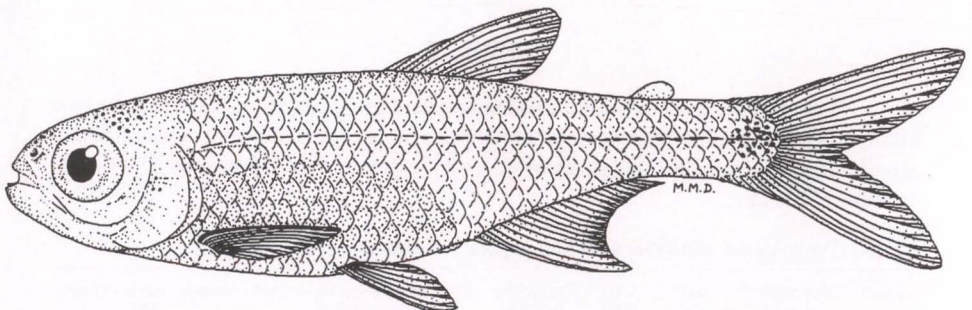


Fig. 2. Specimen of *Holoshesthes heterodon* (MZUSP 51474 and MCP 19927) captured in Cajuru reservoir (scale = 1 mm).

the area to be sampled for each point. The vegetation over the soil was collected in five points, at regular intervals of 10 m from the first assorted point of each transect. The material was dried at 70 °C constant temperature up the stabilization of its dry weight. This sampling was made in the week before the beginning of the water level rising.

In May 1993, when the reservoir was at its maximum level (753,0 m), fish were captured by seining (opening of 1 mm) the littoral zone. Fish samples were taken at 16:00 h and immediately fixed in 10 % formalin. In laboratory they were preserved in 2 % formalin.

Eighteen individuals collected at each station were examined. The average standard length was 1.53±0.05 cm and 1.52±0.05 cm, respectively at the lower biomass (8.19 kg dry weight/ha) and higher biomass (38.10 kg dry weight/ha) sampling stations.

Frequency of occurrence and points methods were applied to the data resulting from the analysis of the stomach contents. Quantitative analysis were performed by stomach repletion index (SRI) (HYSLOP 1980) modified. For the quali-quantitative analysis, the Alimentary Index (IAi) was applied according to KAWAKAMI & VAZZOLER (1980) with the volumetric participation of the items obtained through the points method (HYNES 1950). The equations used are showed below:

$$SRI = \frac{IFW}{BW} \times 100 \quad Iai = \frac{Fi \times Vi}{\sum_{i=1}^n (Fi \times Vi)} \times 100$$

where: (SRI) stomach repletion index (%); (IFW) ingested food weight; (BW) body weight; (IAi) alimentary Index (%); (i) 1, 2,...; (n) determined alimentary item; (Fi) frequency of occurrence (%) of item i; (Vi) volumetric participation (%) of item i.

The values of SRI obtained for both sampling stations were compared by the Mann-Whitney non parametric test (ZAR 1996). Besides vegetal biomass, the following limnological features were taken in each sampling station: temperature, transparency, dissolved oxygen, conductivity and pH.

RESULTS

The limnological conditions did not present great variations between the two stations. However, the relative vegetal biomass of sampling station 1 was 4.6 times smaller than the station 2 and in absolute terms (estimated for all the area), 5.8 times smaller (Tab. I).

Table I. Limnological characteristics and vegetal biomass of sampling stations.

Station	Temperature (°C)		Secchi (m)	D.O. (mg/l)	Conductivity (µS/cm)	pH	Relative vegetal biomass (Kg/ha)	Absolute vegetal biomass (Kg)
	Air	Water						
1	21.2	22.5	1.7	8.4	25.5	7.50	8.19	120.41
2	20.0	21.8	1.8	7.9	25.0	7.44	38.10	693.37

The SRI values were not significantly different between station 1 ($X=1.57\pm 0.95$; C.V.=60.23%) and 2 ($X=1.46\pm 0.86$; C.V.=59.03%), $p > 0.05$. *Cladocera* and insect larvae were the most frequent alimentary items (Fig. 3). In volume, *Cladocera* was the item with the greatest participation for both situations, followed by insects in station 1 and insect larvae in station 2 (Fig. 3). According to the IAI, *Cladocera* was clearly the most important item in both situations, followed by insect larvae (Fig. 4).

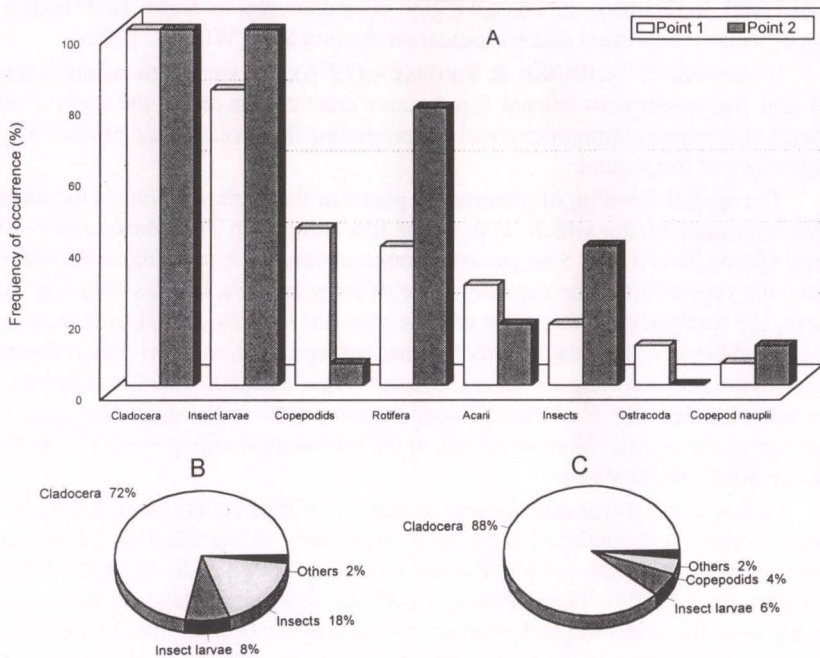


Fig. 3. Frequency of occurrence (A) and volumetric participation of preys in the stomach contents of *H. heterodon* at the lower (B) and higher (C) vegetal biomass stations.

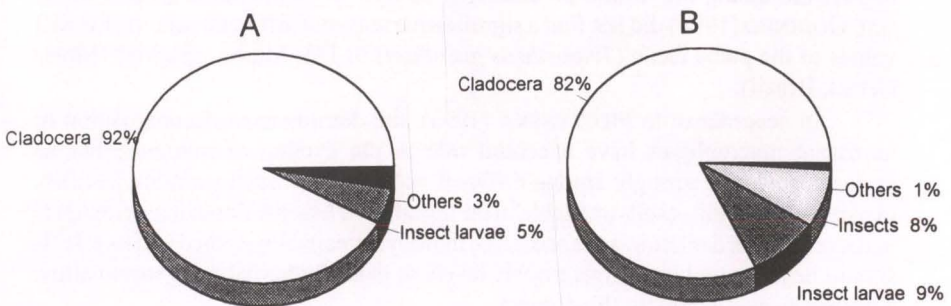


Fig. 4. Relative importance of preys in the stomach contents of *H. heterodon* at the lower (A) and higher (B) vegetal biomass stations, according to the IAI.

DISCUSSION

In reservoirs, a great part of the organic matter comes from the littoral zone. In these environments, the zooplankton supplemented by organisms of the meso-fauna and microfauna, especially insects, is much more diverse than that of the pelagic zone, constituting an important alimentary component for fish (FERNANDO 1994). Consequently, several species procreate in the coastal zone, probably by the greatest availability of food and refuge (BEAM 1983; PLOSKEY 1985; ROZAS & ODUM 1988). In this way, the coastal region is fundamental for these water bodies, being especially important as a biological production area (WETZEL 1990).

In accordance to RYBAK & SIKORSKA (1976), the variations of the water level and the consequent coastal flood cause drastic changes in the cycling of nutrients and in the communities structure, promoting the diversity and productivity maintenance of the system.

The annual flooding of gramineous plants of the depletion zone is the main source of organic matter which supports the fish biomass in Três Marias reservoir (Minas Gerais, Brazil) (Y. Sato personal communication). According to PLOSKEY (1985), the vegetation of the depletion zone of the reservoirs, besides reducing the erosion, the turbidness of the water and the physical injuries caused by waves on the eggs and larvae of fish may greatly increase the reproduction, surviving of young fish, growth and recruiting of several species when flooded. There is a positive correlation between the biomass of flooded macrophytes in the depletion zone of Cajuru reservoir and the biomass of fish in the following flooding season (C.B.M. Alves personal observation).

In this work, it was not possible to make a clear direct correlation between vegetal biomass and intake of food by *H. heterodon* in the flooding period, as suggested by BERNACSEK (1984), PLOSKEY (1985), COHEN & RADOMSKI (1993) and FERNANDO (1994). Nevertheless, as all the stomachs analyzed were full, possibly even the lower vegetal biomass was already enough to provide abundant alimentary resources and to keep water transparency similar to the station 2, allowing the visually guided search for food. The animal biomass and the flooded vegetal necromass (not considered) may have been important sources of organic matter, increasing the littoral productivity, as well as the nutrients present in the soil. GODINHO (1994) did not find a significative seasonal difference among the SRI values of the piaba facão (*Triplotheus guentheri*) in Três Marias reservoir (Minas Gerais, Brazil).

In accordance to PIECZYNSKA (1993), the detritus from decomposition of terrestrial macrophytes have a central role in the cycling of nutrients, but its importance varies strongly among different water bodies. Such variation justifies, in part, the different results available in the literature. Thus, the flood of macrophytes in the reservoirs depletion zone should be more systematically studied and its effects should be measured in various trophic levels so that a better database would allow a deeper discussion about this subject.

In this study, *Cladocera* was the most important alimentary item in the two stations. ALVIM *et al.* (1997) showed the intense predation of *H. heterodon* over

Cladocera attributing to the water transparency, size and shape of the body and the locomotion mechanism of the prey, as the species surveyed behaves as a visually guided predator (ROCHE *et al.* 1993).

They also evidence the necessity of more detailed studies on the importance of the vegetation of the depletion zone for the maintenance of the fish productivity in reservoirs.

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