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Predation of *Jenynsia multidentata* (Jenyns) (Cyprinodontiformes, Anablepidae) on copepods in laboratory conditions

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Abstract. The aim of this study was to evaluate the predation of *Jenynsia multidentata* on copepods. Increasing fish stocking density resulted in reduction in copepods density, showing copepods as an important alimentary item of *J. multidentata* in estuarine earthen ponds.

Key words: Feeding, Fish, Zooplankton.

Resumo. Predação de *Jenynsia multidentata* (Jenyns) (Cyprinodontiformes, Anablepidae) sobre copépodes em condições de laboratório. Este estudo teve por objetivo avaliar a predação de *J. multidentata* sobre copépodes. O aumento da densidade de peixes levou a uma redução na densidade de copépodes, mostrando os copépodes como um importante item alimentar de *J. multidentata* em viveiros de terra.

Palavras-chave: Alimentação, Peixe, Zooplâncton

The culture of fish and marine shrimps in earthen ponds is an activity that comes growing to the long one of the last decades (FAO 2006). In these ponds, diverse studies that were carried out had shown that zooplankton reaches high values of density and biomass in these semi-closed environments (Martinez-Cordova & Peña-Messina 2005, Cardozo *et al.* 2007).

In culture ponds, zooplankton is a link between autotrophic and heterotrophic organisms in the food web (Chakrabarti & Sharma 1998). Zooplankton can be used as a directly food source for the cultivated organisms, as in case of shrimp post-larvae (Cardozo *et al.* 2007), or can be available in the pond to be used for other organisms that are possible preys for the cultivated organisms.

In the estuarine region of Rio Grande - RS, polyculture ponds of flounder (*Paralichthys orbignianus*) and mullet (*Mugil platanus*) are being tested, and in these culture system, mugilidae can act as planktophagous fish (Cardona 1996), impacting phytoplankton and zooplankton (Milstein 1995, Cardona *et al.* 1996, Milstein & Svirsky 1996), while the flounder, use formulated feed as main alimentary item, and can add to it's diet small fishes as *J. multidentata* that are present in flounder diet on the environment (Vieira *et al.* 1998). In estuary, *J. multidentata* have as part of its diet *Ruppia maritima* and some macro algae, with contributions of animal origin items (Mai *et al*. 2006). In the ponds with reduced presence of vegetable items from the diet, *J. multidentata* could use other organisms, as zooplankton in its diet.

The presence of high zooplankton densities, in special copepods, in culture ponds is a current fact in the aquaculture activity (Coman *et al.* 2003, Martínez-Córdova & Peña-Messina 2005, Cardozo *et al.* 2007), and many species use zooplankton as food source due to its high nutritional value (Millamena *et al.* 1990, Munilla-Moran *et al.* 1990, Pillay 1990). On the other hand, in polyculture systems all trophic levels are used justifying this experiment, which had as objective to evaluate the predation of *J. multidentata* on copepods, once these species is an important food source for *P. orbignianus* (Vieira *et al.* 1998) in polyculture ponds, in the estuarine region of Patos Lagoon.

The experiment was carried out at the facilities of Continental Aquaculture Laboratory (LAC) of Fundação Universidade Federal do Rio

Grande, in august 26 and 27 of 2007. For the test, fish and copepods were captured from one polyculture pond (water salinity 6) of *P. orbignianus* and *M. platanus*. Samples of *J. multidentata* were collected from the ponds edge an transferred to an atoxic 30 L plastic bucket (n = 100 fishes), only with water from the pond (salinity 6), where they had been kept for 30 minutes, without food, until the moment of the transference for the bottles where the experiment occurred. Due to the short time in the bucket the organisms don't had emptied their stomachs.

Copepods had been collected in surface samples using a plankton net with 1.5 m of length, diameter of 30 cm and 140 µm mesh size. After the sampling, the material retained in the net was transferred to a 7 L plastic bucket contends filtered water (20 µm) from the pond. The collected organisms had been kept in the bucket until being transferred to the experimental bottles. To estimate the predation of *J. multidentata* on copepods, 4 treatments with three replicates had been used: one control only with copepods (T1), and other three with fish in densities of 2 (T2), 4 (T3) and 8 (T4) fishes.L^{-1}. These densities were used due to the volume of experimental bottles, to avoid a great number of individuals confined in small space.

Initially the transparent glass bottles (2 L) received filtered water (20 µm) from the pond in which fishes and copepods were collected. After this the fishes of approximately same size, that are swimming actively and in good conditions, were distributed in the bottles to obtain the desired densities. To each bottle was added 300 mL of the water contained in the bucket with copepods (initial density of 2974 ± 173 cop.L^{-1} in all bottles), water that were always kept homogenized to guarantee a similar distribution of organisms in all bottles. This initial concentration of copepods used in this experiment occur in earthen ponds, even in higher densities (Martinez-Cordova *et al.* 2002).

Immediately after the introduction of the copepods in all bottles, a new aliquot of 300 mL was fixed in a 4% formaldehyde solution to posterior determination of the initial concentration. The bottles were kept in to an acclimatized room (temperature 20 ± 2 ºC and photoperiod 12L:12D) and receiving constant and gentle aeration. After 24 hours of experiment, the volume of all bottles was retained in a sieve with 45 µm mesh size and fixed in a 4% formaldehyde solution to posterior determination of the copepods density and fish total length.

In order to determinate the copepods density, the fixed samples had been transferred to a known volume beaker of which had been removed an aliquot of 10 mL with a sub-sampler (Boltovskoy 1981). The sub-samples had been transferred to Bogorov counting chambers, and examined under a stereoscope microscope. To obtain the fish total length a caliper was used. To verify if significant differences between the treatments had occurred, the results had been compared using one-way ANOVA, followed by Tukey's test, with 95% of confidence.

The copepods species composition in the samples were mainly dominate by the copepods *Acartia tonsa* and *Pseudodiaptomus richardi*, as much in its adult forms, as also copepodites and nauplii, being *A. tonsa* responsible for more than 95% of the total. To the end of 24 hours all the fishes were alive and swimming actively in the bottles, indicating that they were in good conditions during all the experimental period, so, with 100% of survival.

After 24 hours of experiment were verified in the control bottles (T1) density of 2885 ± 68 cop.L^{-1}, with no significant reduction ($p < 0.05$) of copepods density when compared with the initial value (2932 ± 198 cop.L^{-1}) as expected. In the bottles contend fish, it was observed an inverse relation between the fish density and copepod density, with density values of 2180 ± 365 cop.L^{-1} in T2, 1713 ± 133 cop.L^{-1} in T3 and 893 ± 260 cop.L^{-1} in T4 (Figure 1), with significant differences among treatments.

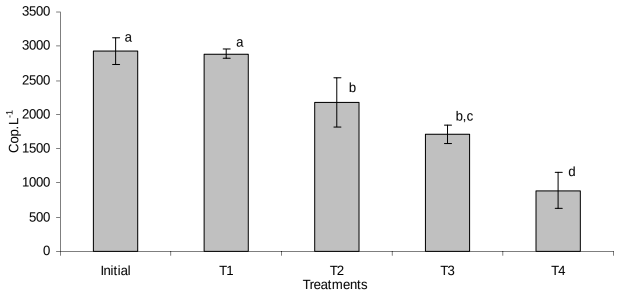

Figure 1. Copepods densities in different treatments. Different letters indicate significant differences (ANOVA, $p < 0.05$)

The fishes used in the test had a mean total length of 28.0 ± 2.4 mm, presenting no statistical differences ($p < 0.05$) in body size. In the different fish densities tested, a decrease in the mean number of ingested organisms per fish was observed, despite no significant differences had been registered, with mean values of 376 cop.$fish^{-1}$ in T2, 304 cop.$fish^{-1}$ in T3, reaching 254 cop.$fish^{-1}$ in T4 (Figure 2).

The presence of *A. tonsa* and *P. richardi* in this test correspond to the environmental conditions observed in the pond, especially salinity, once those species are eurihaline and occur in the Patos Lagoon estuary in salinities since 5 to 30 (Montú *et al.*

1997), just as *J. multidentata*, that tolerate a large variation in salinity (Mai *et al.* 2005).

The mean total length of fishes used in the test, indicates that this organisms are juveniles (Mai *et al.* 2005), because adults can reach 6 to 12 cm (Fischer *et al.* 2004). The density reduction presented with the increase of fish density corroborate with the literature that cites small crustaceans as part of the diet of these fishes (Fischer *et al.* 2004, Mai *et al*. 2006). In culture ponds, were zooplankton are available in great number (Cardozo *et al.* 2007), copepods can be an alimentary item of *J. multidentata*.

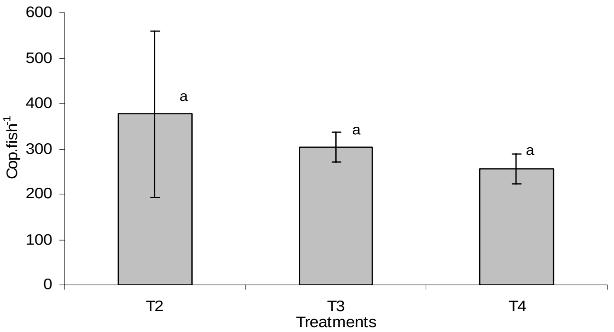

Figure 2. Number of organisms ingested by fish in different treatments. Different letters indicate significant differences (ANOVA, $p < 0.05$).

The reduction in the mean number of ingested organisms with density elevation can be related to the increase in fish density and the space limitation in the experimental units, which can leads to stress conditions in these small experimental units (Lazzaro 1987).

Concerning the idea of polyculture, that is the association of different species of fish in the same pond, feeding in different trophic levels (Billard & Berni 2004), these results indicate that zooplankton, in special copepods, can be one of the alimentary items of *J. multidentata*, which can be one item on the diet of flounders in culture conditions, letting another trophic level opened to *M. platanus*.

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