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PREDATION OF Biomphalaria glabrata DURING THE DEVELOPMENT OF Belostoma anurum (HEMIPTERA, BELOSTOMATIDAE).

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SUMMARY

Belostoma anurum was reared under laboratory conditions. Specimens were exposed to semi-natural conditions of photo period. The mortality rate was 26.3% during the post embryonic period (38.6 ± 0.7 days). During this time the average predation of *Biomphalaria glabrata* was of 99.0 ± 9.4 snails. The mean increment ratio of length and dry weight per instar was of 1.4 ± 0.1 and 2.8 ± 0.5, respectively. The predation by *B. anurum* adults can be divided into two different periods: phase I (4.8 ± 1.4 snails/day) and phase II (1.8 ± 0.5 snails/day). The higher predation in phase I suggested the sexual maturation of the belostomatid.

KEY WORDS: Insecta; Belostomatidae; *Belostoma anurum*; Predation; *Biomphalaria glabrata*.

INTRODUCTION

The species of the genus *Belostoma* are usually found associated with the vegetation in stagnant or low stream waters. Among theirs preys, invertebrates and small aquatic vertebrates are often found.

Some *Belostoma* species have been studied as predators of mosquito larvae [1, 15, 16] and cladocera [2].

The predatory ability of *Belostoma* on snails was observed by TORRE-BUENO [21] and SEVERIM & SEVERIM [19]. According to CULLEN [4], among the preys of *B. malkini* in Trinidad are the mollusks of the genus *Marisa*.

PONTIER & DELPLANQUE [14] consider *B. boscii*, a common species in Guadeloupe, an important element in the regulation of *Biomphalaria glabrata* in that island. On the other hand, *B. flumineum* is an important snail predator in small ponds of the U.S.A. [8].

Previous works quantified the predation on pulmonate gastropods, both by adult belostomatids [3, 12] and by adults and nymphs [8, 14]. However, observation of the predation process during the development of belostomatids has not yet been made.

Although nearly 70 species of *Belostoma* have been described mostly in South America [11], very little is known about the influence of these predators on their preys in that continent.

The purpose of the present paper is to quantify the predation of *B. glabrata* (Gastropoda, Planorbidae) by *B. anurum*, during the development of the belostomatid.

MATERIAL AND METHODS

Adults specimens of *Belostoma anurum* were collected from the Pampulha dam (north region of Belo

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Horizonte, Minas Gerais, Brazil). The belostomatids were kept, under laboratory conditions, in tanks (500 L) with a continuous tap-water flow and provided with synthetic floats. *Biomphalaria glabrata* served as food until spawning.

To quantify predation, 19 nymphs of the first instar, after the eclosion, were isolated in glass recipients containing 200 ml of non-chlorinated tap water and a piece of expanded polystyrene to hold the insect. After the last ecdysis, 6 adults (3 couples) were separated individually and inspected for 22 days.

Feeding consisted of *B. glabrata* specimens reared at the laboratory [8], with shell diameters varying from 1 to 18 mm, in sufficient quantity that some prey remained alive when the food was renewed. Water and food were changed daily and the preyed snails were counted and measured.

The estimation of the dry weight of the whole body of belostomatids and soft tissues of planorbids (both dried in a heater at 70°C for 24 hours) was performed three times. The specimens used for the evaluations of the dry weight at different instars of *B. anurum* were collected from the Pampulha dam. The snails with 3, 5, 10, 15 and 20 mm diameter were sacrificed by freezing following decalcification [5].

Thus, from the respective dry weights/ snails shell diameter of 3 mm (0.8 ± 0.9 mg), 5 mm (2.9 ± 1.6 mg), 10mm (12.8 ± 6.1 mg), 15 mm (35.2 ± 26.5 mg) and 20 mm (90.1 ± 14.7 mg), the linear regression equation ($Y = 0.204\ X + 0.329$, $r^2 = 0.993$) was obtained, where Y is the cubic root of the mollusk dry weight (mg) and X is the planorbid diameter (mm). This equation was used to estimate the dry weight of snails with 1 to 18 mm of diameter.

The experiments were carried out between spring and the beginning of summer (October and December). The temperature was 25.1 ± 1.7°C. The belostomatids were kept under semi-natural photo period conditions.

RESULTS

The mortality during the post embryonic development period was 5 specimens distributed among the 1st (2 specimens), 4th (2 specimens) and 5th (1 specimen) instars.

During the nymphal period (38.6 ± 0.7 days), the predation of the 14 specimens of *B. anurum* that reached the adult stadium was 99.0 ± 9.4 planorbids. The dry weight value of preyed snails (considering that the belostomatid devoured its prey completely during the experiment) was 605.5 ± 51.4 mg (Table 1).

An increase in the numbers, dry weight and diameter of the snails preyed during the post embryonic development of belostomatid was found. The mean increment ratio of lenght and dry weight per instar was of 1.4 ± 0.1 and 2.8 ± 0.5, respectively.

The higher predation occurred during the first half of the second to the fifth instars (Student's t test, $p<0.05$). For the first instar no significant difference was verified (Fig. 1).

The predation of *B. glabrata* by *B. anurum* adults for 22 days of observation can be divided into two distinct periods (Fig. 2). The first period (phase I) lasted

TABLE 1

Diameter, number, dry weight for snail preyed; duration of each instar, dry weight and length of belostomatids.

Instar	Diameter of preyed snails (mm)	Number of preyed snails	Dry weight of preyed snails (mg)	Duration (days)	Dry weight of belostomatids (mg)	Length of belostomatids (mm)
1°	2.8 ± 0.9	11.5 ± 1.9	9.2 ± 1.8	6.8 ± 0.4	1.1 ± 4.7	5.2 ± 0.4
2°	3.7 ± 1.1	13.2 ± 2.7	18.8 ± 3.1	5.9 ± 0.5	3.7 ± 1.9	7.8 ± 0.4
3°	4.8 ± 1.6	17.1 ± 3.9	45.3 ± 10.7	6.6 ± 0.5	10.8 ± 9.1	11.3 ± 0.5
4°	6.4 ± 2.4	24.8 ± 4.2	139.7 ± 22.7	8.6 ± 0.7	22.8 ± 11.7	16.0 ± 0.7
5°	9.2 ± 2.7	32.4 ± 4.4	392.5 ± 55.7	10.6 ± 0.6	59.3 ± 69.5	22.6 ± 0.5
Adult	11.2 ± 2.9	-	-	-	177.2 ± 22.4	33.9 ± 1.3
Total	-	99.0 ± 9.4	605.5 ± 51.4	38.6 ± 0.7	-	-

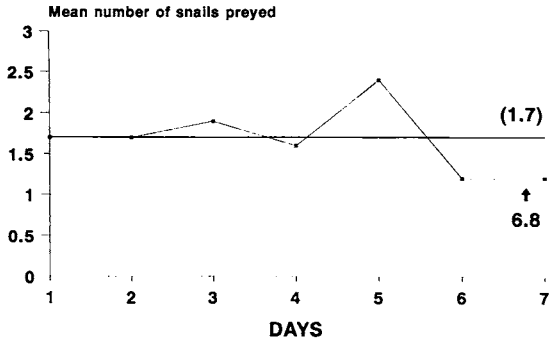

Fig. 1A

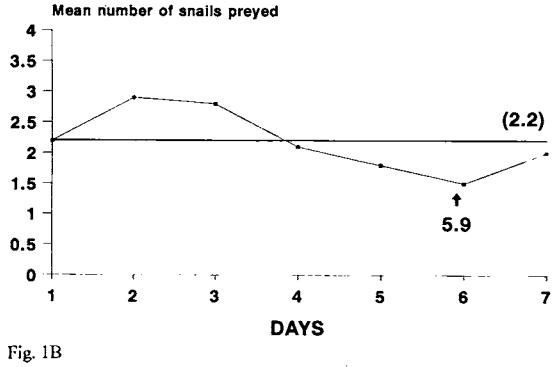

Fig. 1B

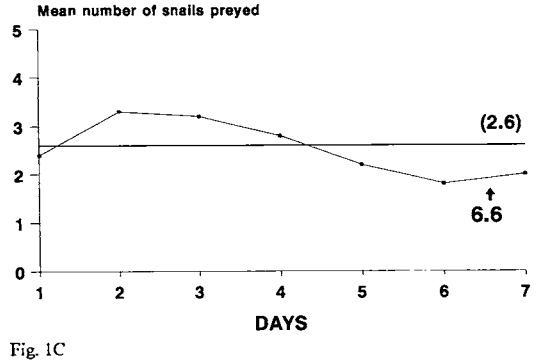

Fig. 1C

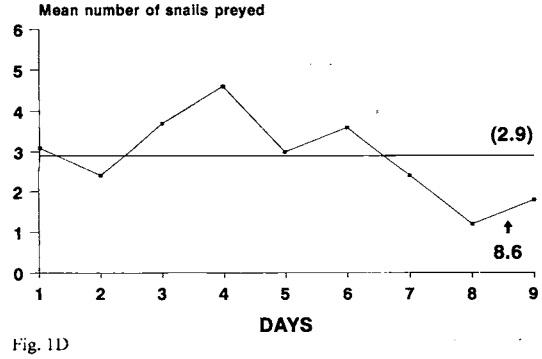

Fig. 1D

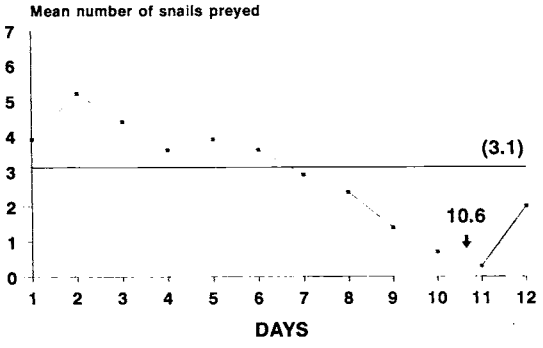

Fig. 1E.

Figure 1 - The mean number of *B. glabrata* preyed by each instar of *B. anurum* (N=14). A:1st, B:2nd, C:3rd, D:4th and E:5th instar. ( ) The average predation of each stadium. ↑ Mean duration of each instar.

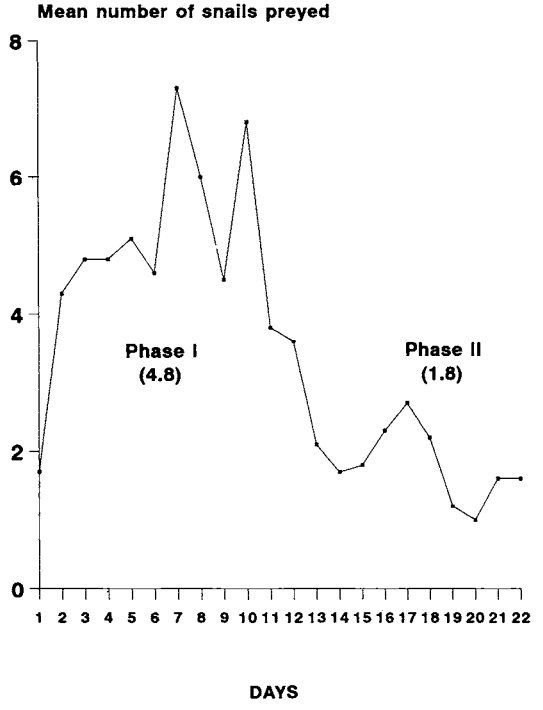

Figure 2. The mean number of *B. glabrata* preyed by 6 adults of *B. anurum* separated after the last ecdysis, during 22 days. ( ) The average predation of each phase.

12 days and showed a predation of 4.8 ± 1.4 planorbids per day. The second period (phase II), which began in the 13th day, showed a predation of 1.8 ± 0.5 mollusks per day (Student's t test, $p<0.05$).

During the observation period, the preyed snails by the adult belostomatids presented a diameter of 11.2 ±

2.9 mm, and the predation rate was of 2.9 ± 1.3 snails for males and 3.9 ± 2.7 for females.

The daily consumption of snails in dry weight (mg) can be represented by the linear regression equation Y = 0.614 X + 0.941 (r^2 = 0.997, and X = the dry weight (mg) of each instar). The daily estimated value of consumption for the adults in phase I (87.7 mg) and in phase II (32.1 mg) was respectively bigger and smaller than the average obtained on the 5th instar (37.0 mg). It was verified a ratio variation from 1.2 for the first instar to 0.2 for the adult in phase II, when the daily consumption of snails in dry weight (mg) and the belostomatid's average dry weight in each instar (mg) was compared.

DISCUSSION

In the present work, the survival observed during the post embryonic development of *B. anurum* was satisfactory (73.7%) considering the mortality obtained in other laboratory breeding of *Belostoma*, in general, higher than 50% [9, 14, 17, 18, 20]. Recently, however, McPHERSON & PACKAUSKAS [10], in the breeding of *B. lutarium*, obtained survival indices of 64.2% and PEREIRA et al [13], with *B. micantulum*, obtained survival indices of 92.6%.

Little is known about the belostomatid preference for the size of prey. The data obtained indicate the preference of *B. flumineum* for *Physa vernalis* and *Pseudosuccinea columella* of larger prey size [8].

The rate between the diameter of preyed *B. glabrata* and the average of length of belostomatids, throughout the nymphal period verified in this work, ranged from 0.4-0.5. For the dry weight value of preyed snails and the belostomatid, the rate ranged from 0.2-0.6.

On the other hand, PONTIER & DELPLANQUE [14], using larger specimens of *B. glabrata* for rearing *B. boscii*, detected a high mortality rate during the post embryonic development. This fact is probably associated with the food manipulation by the predator.

In this work, a decrease in the predation rhythm has been observed simultaneously with an increase of the duration of the nymphal stadium. It seems to occur a pause in the belostomatid feeding before the ecdysis, more evident in the 5th instar.

The predation of *B. glabrata* by *B. anurum* in phase I must probably be related to the belostomatid sexual maturation, since in the phase II it is possible to observe oocytes, throught transparency, in the female abdomen. The predation of 1.8 ± 0.54 snails per day, observed in the second period (phase II) was higher than that previously obtained [12], in similar conditions, but using 10 month-old specimens. It was found 1.3 ± 0.4 snails preyed per day with an average diameter of 7.8 ± 2.4 mm, probably owing to the age of the belostomatid. It is possible that predation rates have higher oscillation in nature than under experimental conditions (isolated specimens). The rhythm of predation after the female laying and incubation of the eggs by the males is unknown.

Under the present experimental conditions, the preys were found to be not entirely devoured, some soft parts of the preyed snails being found at the end of the experiment. This finding is in agreement with the data obtained for the belostomatid *Diplonychus rusticum*, which decreases the handling time with the increase of the prey density [6].

RESUMO

Predação de *Biomphalaria glabrata* durante o desenvolvimento de *Belostoma anurum* (Hemiptera, Belostomatidae).

Belostoma anurum foi criada no laboratório em condição semi-natural de fotoperíodo. A taxa de mortalidade durante o período pós-embrionário (38,6 ± 0,7 dias) foi de 26,3%. Durante este período a predação média de *B. glabrata* foi de 99,0 ± 9,4 caramujos. A média de incremento de comprimento e de peso seco por estádio ninfal foi de 1,4 ± 0,1 e 2,8 ± 0,5, respectivamente. A predação por adultos de *B. anurum* pode ser dividida em duas fases significativamente distintas: fase I (4,8 ± 1,4 caramujos/dia) e fase II (1,8 ± 0,5 caramujos/dia). A maior predação verificada na fase I deve-se provavelmente à maturação sexual do belostomatídeo.

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