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COMPETITIVE DISPLACEMENT OF *BIOMPHALARIA GLABRATA* BY *B. STRAMINEA*

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Data on the interaction between populations of closely related species of Biomphalaria, B. glabrata *and* B. straminea, *are presented in the current paper. Laboratory and field observations and experiments have shown that* B. straminea *has competitive advantages over* B. glabrata.

Observations made in the coastal area of northeastern Brazil during three consecutive years (1952-1954) provided empirical data on the competitive relationships of two closely related *Biomphalaria* species. Occasional introduction of *B. straminea* is an area, at the outskirts of the town of Recife, known for several years to be inhabited exclusively by *B. glabrata*, allowed the study of the behaviour of these planorbid species competing in the same body of water. *B. glabrata* was totally eliminated and substituted by *B. straminea.* This was tentatively explained as a case of competitive displacement phenomenon (Barbosa, 1973). Two possibilities were suggested to explain the break of the population stability of *B. glabrata:* the higher susceptibility of *B. glabrata* to the infection with *Schistosoma mansoni* which produces a definitive killing effect on the infected snails, and the higher resistance of *B. straminea* to dessication a condition that favors this species in an area subject to a natural cyclic dry season.

These studies were resumed in the last years beginning with the development of a special program in the "Research Center Aggeu Magalhães" in Recife. An uniform seminatural environment was created and the snails were bred in indoor cement channels (Barbosa et al., 1983). At the same time two field areas were selected, one for observations on natural competition between the two species located in the counties of Olinda and Paulista, state of Pernambuco, and another in the county of Alhandra, state of Paraíba, used for experimental introduction of *B. straminea* in a valley dominated exclusively by a natural population of *B. glabrata.*

For all the experiments two strains of *B. straminea* were used: R3, an albino strain (kindly supplied by Dr C. Richards, USA) resistant to the infection with *S. mansoni* and PT, an albino, black eyes, Brazilian strain partially resistant to the infection with the above schistosome species.

LABORATORY STUDIES

The superiority of *B. straminea* over *B. glabrata* was demonstrated in some laboratory experiments. In a channel measuring 3.5 m long by 35 cm water surface width holding 80 l of water, as described in detail (Barbosa et al., 1983) *B. straminea* excluded *B. glabrata* after the period of 100 weeks (Barbosa et al., 1984), as shown in Table I and in the Graph.

TABLE I

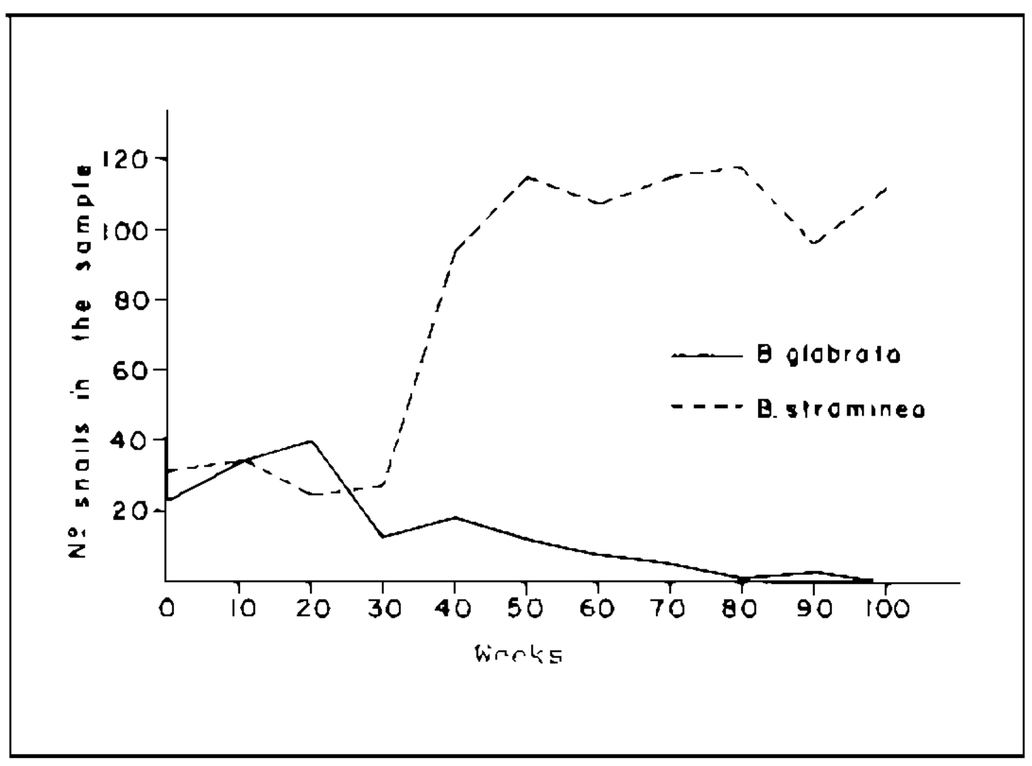
Competitive interactions between *Biomphalaria straminea* and *Biomphalaria glabrata*

Week	Number of snails in the sample	
	B. glabrata	*B. straminea*
10	33	33
20	35	25
30	13	27
40	19	95
50	11	117
60	7	108
70	5	119
80	1	120
90	3	97
100	0	112

Snail countings made at ten week intervals.

Other laboratory experiment, carried out in cement channels, showed that under population pressure, *B. straminea* has higher capability to migrate towards a new unoccupied territory than *B. glabrata. B. straminea* is a more vagile species than *B. glabrata* invading more rapidly the territory occupied of the latter species

(Barbosa et al., 1984). Yet, results of a comparative experiment showed that *B. straminea* has higher capability than *B. glabrata* to resist drying. This experiment was carried out in a cement tank measuring 2.00 m long x 0.64 wide placed outside the main building. The open surface of the tank was screened to avoid penetration of predator animals. A roof was placed over the tank in such a way that a space was left between the cover and the up border of the tank, allowing ventilation and avoiding excessive temperatures and occasional rains (Barbosa et al., 1985).



Competitive interactions between *Biomphalaria straminea* and *B. glabrata*.

FIELD STUDIES

Observational study – observations were made in a territory covering two counties located in the humid coastal area of the state of Pernambuco as previously mentioned (Barbosa et al., 1981).

Since 1951, the coastal and forest regions of the state of Pernambuco have been utilized for frequent snail collections to service the research and routine activities carried out by the Research Center Aggeu Magalhães. These extensive field activities, developed in the coastal region of the state of Pernambuco, during the period 1951-1956, provided detailed knowledge of the distribution of *B. glabrata* and *B. straminea*. From 1957 these field activities decreased and were intensively resumed in 1978 when some specimens of *B. straminea* were found in areas formerly occupied by *B. glabrata* (Barbosa et al., 1981).

Systematic collections were than carried out during the period 1979-80 in the territories formely occupied by *B. glabrata* demonstrating that *B. straminea* had invaded new areas and in some of them became the only *S. mansoni* snail host present. In other words, *B. glabrata* have been excluded by *B. straminea* from a large part of its former territory. At present, it is a hard task to find specimens of *B. glabrata* in the county of Paulista where it was the only species in the period of 1951-56. In the county of Paulista during the period 1951-1956 *B. straminea* was not found among over 56,000 collected snails. The reverse was seen during the recent collecting period (1979-80), when only 141 *B. glabrata* specimens were found while 9,194 *B. straminea* were collected. In the county of Olinda, in the period 1979-1980, *B. glabrata* was still present in fairly large numbers. However, *B. straminea* has increased markedly during the interval of nearly two decades between the collecting periods as shown in Table II (Barbosa et al., 1981).

TABLE II

Number of snails collected in the counties of Olinda and Paulista, state of Pernambuco, Brazil, during the periods 1951-1956 and 1979-80

Period	Olinda		Paulista	
	B. glabrata	*B. straminea*	*B. glabrata*	*B. straminea*
1951-56	9301	917	56586	0
1979-80	5098	17295	141	9194

Experimental study (unpublished data) – in the county of Alhandra, state of Paraíba, a valley, comprising one main small river and eleven tributaries, was chosen for the development of an experimental study. The valley was known for several years as being inhabited, exclusively by *B. glabrata*.

During the period of one year (1981-82) a population dynamics study of the natural population of *B. glabrata* was carried out in the valley. This study confirmed that the above planorbid was the only species found in the area. After the completion of this pre-experimental study, the already mentioned R3 resistant strain of *B. straminea* began to be introduced in the area at intervals of two months. Evaluations of the competitive process *glabrata x straminea* were made at the same periods just before the introduction of the

competitor. Following March 1986 evaluations were made twice a year. The last quantitative evaluation made in July 1987 showed that the number of the target population snails *(B. glabrata)* was drastically reduced. At that moment the balance of the total snail population in the area was favorable to the competitor (80% for *B. straminea* against 20% of *B. glabrata*).

Comments – Hubendick (1958), for the first time, expressed the opinion that natural selection may favor an unsusceptible strain of the snail intermediate host of schistosomiasis, raising the possibility of the development of a method of biological control by competition between resistant and susceptible snail strains. Richards (1970) developed techniques for selection of refratory strains of *Biomphalaria glabrata* and *B. straminea* and suggested that the combination of certain genetic conditions could favor the process of natural selection of unsusceptible strains. Wright (1971) commenting on Richards' paper states that such studies provide a most important basis for a possible method of biological control of the schistosome snail hosts.

The competitive superiority of *B. straminea* over *B. glabrata* has been described in recent papers by Michelson & Dubois (1979), Guyard & Pointier (1979); and Barbosa et al. (1981).

The laboratory experiments carried out by Michelson & Dubois (1979) and Barbosa et al. (1984) have clearly shown that *B. straminea* is a dominant species when confronts *B. glabrata*, being able to displace the later species under conditions already described. *B. straminea* is a more agressive species in the sense that is capable to invade the territory already occupied by *B. glabrata*. The former species is as more resistant to desiccation than *B. glabrata* confirming previous suggestions (Barbosa & Olivier, 1958). There is some evidence showing that resistance to drought allied to other factors, may favor *B. straminea* during the competitive process in areas where drying is the main disturbing factor in the life cycle of the freshwater snail populations as it is in northeastern Brazil (Barbosa, 1973 and Barbosa & Olivier, 1958).

In the field, Barbosa (1973), Barbosa et al. (1981), and Guyard & Pointier (1979) have shown that *B. straminea* is capable to invade and occupy territories inhabited by *B. glabrata*.

The competitive displacement process is slow as expected, both under laboratory and field conditions. The follow up of the ingoing observations and experiments, and additional and continuous studies on genetics and ecology of the schistosoma vectors of schistosomiasis are needed for a better understanding of the relationships between competitors and target snail populations.

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