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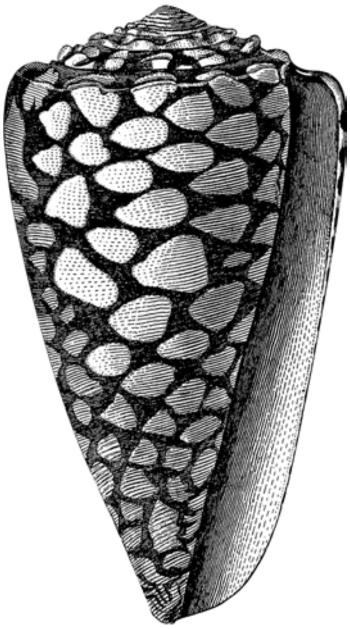

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All enquiries should be directed to:

Molluscan Research
CSIRO Publishing
PO Box 1139 (150 Oxford St)
Collingwood, Vic. 3066, Australia

Telephone: +61 3 9662 7629
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Destruction of *Indoplanorbis exustus* (Planorbidae) eggs by *Pomacea bridgesi* (Ampullariidae)

G. Aditya and S. K. Raut[A]

Ecology and Ethology Laboratory, Department of Zoology, University of Calcutta, 35 Ballygunge Circular Road, Kolkata, 700 019, India.
[A]To whom correspondence should be addressed. Email: jayantadhar@vsnl.net

Abstract.

Six size classes (5–9 mm, 10–14 mm, 15–19 mm, 20–24 mm, 25–30 mm and 30–34 mm) of the ampullariid snail *Pomacea bridgesi* were experimentally exposed to 10–25 egg capsules of the planorbid snail *Indoplanorbis exustus*. With one exception, in all the trials performed with the snails of the four highest size classes, egg capsules of *I. exustus* were destroyed by *P. bridgesi*, whereas in the 5–9 mm and 10–14 mm size classes, egg capsules were destroyed in 20% and 68.96% of trials respectively. An individual of *Pomacea* belonging to each of the six size classes could destroy, on average, 0.28, 2.27, 2.38, 3.82, 3.75 and 3.62 egg capsules, respectively, during a period of 24 hours. Irrespective of size class, an individual could consume 0–6 (average 1.57 ± 0.08 s.e.) and damage 0–9 (average 1.14 ± 0.10 s.e.) egg capsules per 24 hours. On average there are about 20 eggs in each capsule, so an individual of *P. bridgesi* would be able to destroy around 60 eggs of *I. exustus* daily. These observations are relevant to possible biological control of *Indoplanorbis*.

Introduction

The planorbid snails of the species *Indoplanorbis exustus* (Deshayes, 1834) are involved with the spread of schistosomiasis, fasciolasis and amphistomiasis in domestic animals (Malek and Cheng 1974; Chen *et al.* 1986; Biswas 1991) and sometimes fasciolasis and amphistomiasis in humans (Biswas 1991) in a number of South-East Asian countries (Subba Rao 1989). Various attempts to control these snails have failed, and searches for suitable biological control agents are still in progress. In 1992, the ampullariid snail *Pomacea bridgesi* (Reeve, 1856) was introduced in West Bengal, India, from Thailand in connection with the aquarium trade (Raut and Aditya 1999). They are thriving well in different rearing centres of West Bengal, fulfilling Baker's (1998) prediction regarding establishment of *Pomacea* snails in India. We had the opportunity to develop a stock in our laboratory by culturing a few individuals received from a trader (Raut and Aditya 1999). In our laboratory, the snails fed on a number of food items including the egg masses of the fresh water vector snails *I. exustus* (Aditya and Raut 2001), which prompted us to carry out experiments to ascertain the efficacy of *P. bridgesi* in the control potential of *I. exustus*. The results are presented here.

Materials and methods

Ten glass aquaria, each measuring 14 cm^3 were used for the experiments. Each aquarium was filled with pond water (2.5 L). Forty to fifty reproducing individuals of *I. exustus* were placed in each aquarium and fed with lettuce. After 24 hours the aquaria were emptied of water and snails. The number of egg capsules deposited on the glass wall of the aquaria was counted and recorded. If fewer than 10 egg capsules were recorded, the aquarium was not used for experiment. An individual of *P. bridgesi* was taken from the laboratory culture stock and allocated to one of the following size classes (shell length): 5–9 mm; 10–14 mm; 15–19 mm; 20–24 mm; 25–29 mm; and 30–34 mm. Fresh pond water and the *Pomacea* were added and left for 24 hours. After 24 hours the numbers of egg capsules consumed and damaged (due to rupturing and biting) were counted. Each individual of *P. bridgesi* was used only once in the experimental trials. A total of 169 trials (see Table 1) were performed. In each case, there were 10–25 egg capsules of *I. exustus*

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in each aquarium and in all the experiments the snails were not offered any other kind of food. In some cases, bitten and ruptured egg capsules were kept under observation to note the fate of the eggs. One-way analysis of variance (ANOVA) was applied (Campbell 1989) to determine the effects of the size classes on the rate of destruction of *I. exustus* egg capsules. All data are presented as average ± standard error (s.e.).

Results

Destruction of *Indoplanorbis exustus* eggs varied with the experimental trials and the size of the individuals of *Pomacea bridgesi* used (Table 1). Of the 25 trials with 5–9 mm *P. bridgesi*, egg capsules were damaged in only five (20%) trials (two with 8 mm and three with 9 mm individuals) with 1–2 egg capsules damaged through repeated biting. Out of 29 trials with 10–14 mm *P. bridgesi*, nine snails did not touch the egg capsules at all and 11 snails ruptured 2–6 egg capsules. On average, each individual swallowed 2–4 and ruptured 1–2 egg capsules in each trial with 14 mm *P. bridgesi*. All the 32 (100%) trials carried out with 15–19 mm snails were effective in destroying the egg capsules, though the rate of damage due to consumption was higher (63.16%) than that due to rupturing (36.84%). *Pomacea bridgesi* in the 20–24 mm size class consumed almost three times more egg capsules than the number of egg capsules they ruptured, i.e. 73.8% were consumed and 26.2% were damaged. Of the 32 trials with 25–29 mm snails, egg capsules were destroyed in 31 (96.87%) cases. All the 29 (100%) 30–34 mm snails destroyed between 1 and 7 (average 3.62 ± 0.23) egg capsules. Individuals belonging to the 25–29 mm and 30–34 mm size classes consumed and ruptured (on average) 63.33% and 36.67% and 53.33% and 46.67% egg capsules respectively.

Irrespective of size class, out of a total 169 trials performed, 139 (82.25%) *Pomacea* were effective in destroying the egg capsules of *I. exustus*. Of the total 458 egg capsules destroyed, 266 (58.08%) were swallowed and 192 (41.92%) were ruptured by the predators. Each individual of *P. bridgesi* destroyed, on average, 2.71 ± 0.11 egg capsules (1.57 ± 0.08 due to feeding and 1.14 ± 0.10 due to rupturing) during a period of 24 hours. In all cases

Table 1. Number (range and mean ± s.e.) of *I. exustus* egg capsules consumed, damaged and destroyed by *P. bridgesi* individuals from different size classes during a 24 hour period

Size classes of *P. bridgesi*	Number of trials (1 individual per trial)	Number of *I. exustus* egg capsules Consumed	Damaged	Destroyed (consumed + damaged)
5–9 mm	25	0	0–2 (0.28 ± 0.11)	0–2 (0.28 ± 0.11^{abcd})
10–14 mm	29	0–4 (0.83 ± 0.21)	0–6 (1.45 ± 0.21)	0–6 (2.27 ± 0.23^{ae})
15–19 mm	32	0–5 (1.5 ± 0.21)	0–3 (0.88 ± 0.18)	1–5 (2.38 ± 0.2^{efgh})
20–24 mm	22	1–6 (2.82 ± 0.36)	1–4 (1.00 ± 0.21)	3–6 (3.82 ± 0.19^{bf})
25–29 mm	32	0–6 (2.38 ± 0.26)	0–9 (1.38 ± 0.35)	0–9 (3.75 ± 0.38^{cg})
30–34 mm	29	0–5 (1.93 ± 0.2)	0–7 (1.69 ± 0.26)	1–7 (3.67 ± 0.22^{dh})
Overall	169	0–6 (1.57 ± 0.08)	0–9 (1.14 ± 0.1)	0–9 (2.71 ± 0.11)

Groups sharing a common letter differ significantly, for f: $P < 0.05$, in all other cases $P < 0.001$.

the eggs belonging to the bitten and ruptured capsules perished. A summary of the results is given in Table 1. ANOVA tests clearly show that larger sized *P. bridgesi* cause significantly ($P<0.001$) greater destruction of *I. exustus* egg capsules.

Discussion

The results suggest that *Pomacea bridgesi* could help to reduce the abundance of *Indoplanorbis exustus* through egg predation. *Indoplanorbis exustus* deposits 2–43 (average 20) eggs per capsule (Islam 1977; Raut and Ghosh 1985; Raut 1986; Raut *et al.* 1992). The results indicate that large individuals of *P. bridgesi* are capable of destroying around three egg capsules in 24 hours, thus destroying at least 60 embryonic-stage individuals of *I. exustus* daily. Furguson (1978), Pointier *et al.* (1988) and Cazzaniga (1990) have also reported ampullariid predation of the eggs, young and adults of *Biomphalaria* and have suggested several species of Ampullariidae as agents for the control of planorbid snails. Because *P. bridgesi* individuals in the 20–24 mm size class are effective in destroying eggs of *I. exustus*, and there exists no significant difference in the rate of predation among the members of even larger size classes, large *P. bridgesi* (>20 mm in length) can be considered as potentially suitable for a biological control program. *Indoplanorbis exustus* produces about 60 egg capsules in its average life span of four months (Raut *et al.* 1992). Under conditions similar to those in the experiments described in this paper, it is likely that a single *P. bridgesi* in one of the most effective size classes could destroy all these egg capsules within three weeks.

Pomacea bridgesi could be considered as a potential biological agent for the control of *I. exustus* in India and other countries. However, careful studies are required to ascertain whether this species would cause unacceptable environmental impacts. In many countries where they have been introduced, *Pomacea* snails, especially *P. canaliculata* (Lamarck), have contributed to the decline of native species (e.g. *Pila* in South-East Asia) (Acosta and Pullin 1991), the damage of paddy plants, especially rice (Godan 1983) and taro (Cowie 1993), and are suspected of acting as intermediate hosts of certain human diseases (Cheng and Alicata 1965; Hanning and Leedom 1978). Extreme caution should therefore be taken before employing these snails in any form of biological control. Since *Pomacea* has the potential to colonise Bangladesh, Burma and rice-producing areas of Australia (Baker 1998), the present information may prove helpful in assessing the impact of these predaceous snails, if ever introduced, on the ecology of the habitats concerned.

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