

## OBSERVATIONS OF LAND SNAILS FEEDING ON THE EGGS OF *POMACEA CANALICULATA* (LAMARCK, 1822) (MOLLUSCA: GASTROPODA)

T. H. Ng\* and S. K. Tan

Raffles Museum of Biodiversity Research, Department of Biological Sciences  
National University of Singapore, 6 Science Drive 2, Singapore 117546, Republic of Singapore

(\*Corresponding author: [tinghui@nus.edu.sg](mailto:tinghui@nus.edu.sg))

### INTRODUCTION

*Pomacea canaliculata* (Lamarck, 1822) — also known as the channelled apple snail or golden apple snail — is among the 100 of the world's most invasive species (Lowe et al., 2000). From Taiwan where it was first intentionally introduced and cultivated as a food source, this South American snail rapidly spread to other parts of Asia in the 1980s (Naylor, 1996). In Singapore, this alien species was introduced via the aquarium trade, and is currently well-established in the reservoirs and other water bodies (Yeo & Chia, 2010).

Various taxa have been recorded to predate on *Pomacea canaliculata* juveniles and adults in experimental conditions (Kondo & Tanaka 1989; Halwart et al., 1998; Carlsson et al., 2004). However, predation on *Pomacea* eggs appears to be less common. Researchers who tasted the eggs of *Pomacea paludosa* found them unpalatable, whereas egg-tasting experiments conducted with various animals yielded inconclusive results (Snyder & Snyder, 1971). Recent research has found that the eggs of *Pomacea canaliculata* contain proteins that are resistant to digestion and neurotoxins lethal to rats in experiments, and this could explain the relative absence of predators and bright warning colours (Dreon et al., 2010). Nonetheless, invertebrates may be less deterred by the anti-predatory properties of *Pomacea* eggs (Kushlan, 1978). Insects and other invertebrates such as the tropical fire ant (*Solenopsis geminata*), grasshoppers, gyrid beetles, and millipedes have been observed to predate upon the eggs (Snyder & Snyder, 1971; Kushlan, 1978; Yusa, 2001), and adult apple snails are also known to cannibalise submerged eggs (Horn et al., 2008).

On 27 Aug. 2009, at approximately 1930 hours at Kranji Reservoir Park, a lone *Bradybaena similaris* (Férussac, 1821) was encountered apparently feeding on a cluster of *Pomacea canaliculata* eggs on the bank of the reservoir (Fig. 1). The snail was observed for about 10 minutes and it continued to stay in the same position except for slight movements of its head. We returned to the site about 30 minutes later and found the snail gone. A small gap was left in the egg cluster and remnants of eggs in the form of hollowed-out broken shells were visible (see Fig. 2). From a search of the literature, no reports of land snails feeding on the eggs of *Pomacea canaliculata* were found, and a simple experiment was carried out to verify the possibility of land snails eating the eggs of *Pomacea canaliculata*. The results are herein reported and discussed.

### MATERIAL AND METHODS

Two species of land snails, the alien *Achatina fulica* Bowdich, 1822, and the native *Quantula striata* (Gray, 1834) were collected from a Singapore garden and placed individually in separate, covered plastic tanks (120 × 160 × 85 mm). Egg clusters of *Pomacea canaliculata* were collected from a canal adjacent to the Lower Seletar Reservoir. The eggs were reddish-pink, indicating that they were freshly-laid. Each egg cluster was photographed before being introduced to the tanks containing the snails. Each of the plastic tanks now contained one cluster of eggs, and a snail. The environment was kept humid by misting daily with a hand-held water sprayer. The animals were kept for seven days and the egg clusters were visually inspected daily for signs of damage.

### RESULTS AND DISCUSSION

After one day, inspection of the egg clusters showed some signs of depredation in all tanks. On the 2<sup>nd</sup> and 3<sup>rd</sup> days consecutively, *Quantula striata* was observed feeding on the egg masses (Fig. 3), but the tank containing *Achatina fulica* did not show further damage. The egg clusters in the tanks containing *Quantula striata* was progressively lost and by the end of the experimental period, markedly reduced in size (Fig. 4) whilst the egg cluster in the *Achatina fulica* tank appeared untouched after the first day (Fig. 5). As the aim was to determine if land snails are able to predate on



Fig. 1. *Bradybaena similaris* adult (shell width = 15 mm) apparently feeding on a cluster of *Pomacea canaliculata* eggs.



Fig. 2. A gap in the cluster of *Pomacea canaliculata* eggs at the position where the *Bradybaena similaris* had earlier been directed towards. Scale bar = 5 mm.





Fig. 3. *Quantula striata* (shell width = 25 mm) feeding on *Pomacea canaliculata* eggs in the laboratory.

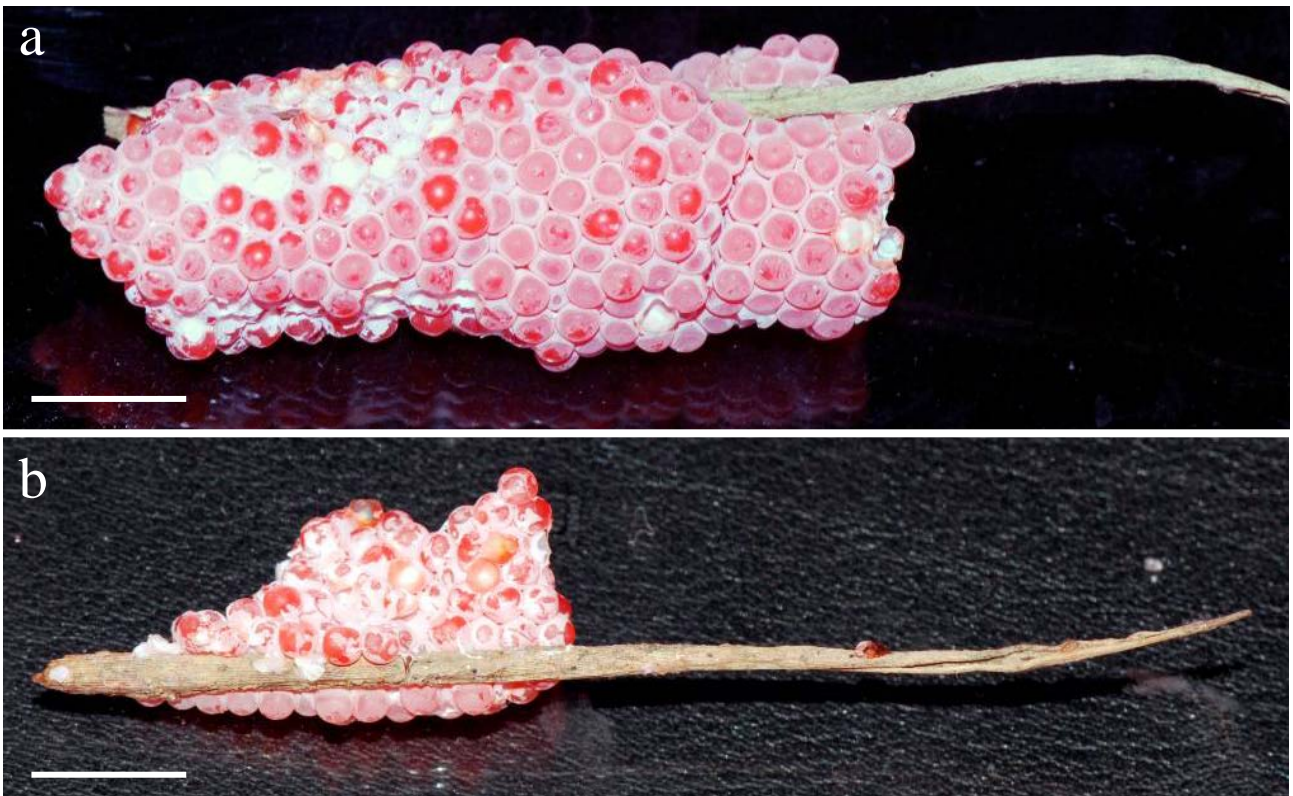


Fig. 4. Egg cluster placed in tank with *Quantula striata* at start of observation period (a). Same egg cluster after seven days (b). All scale bars = 10 mm.

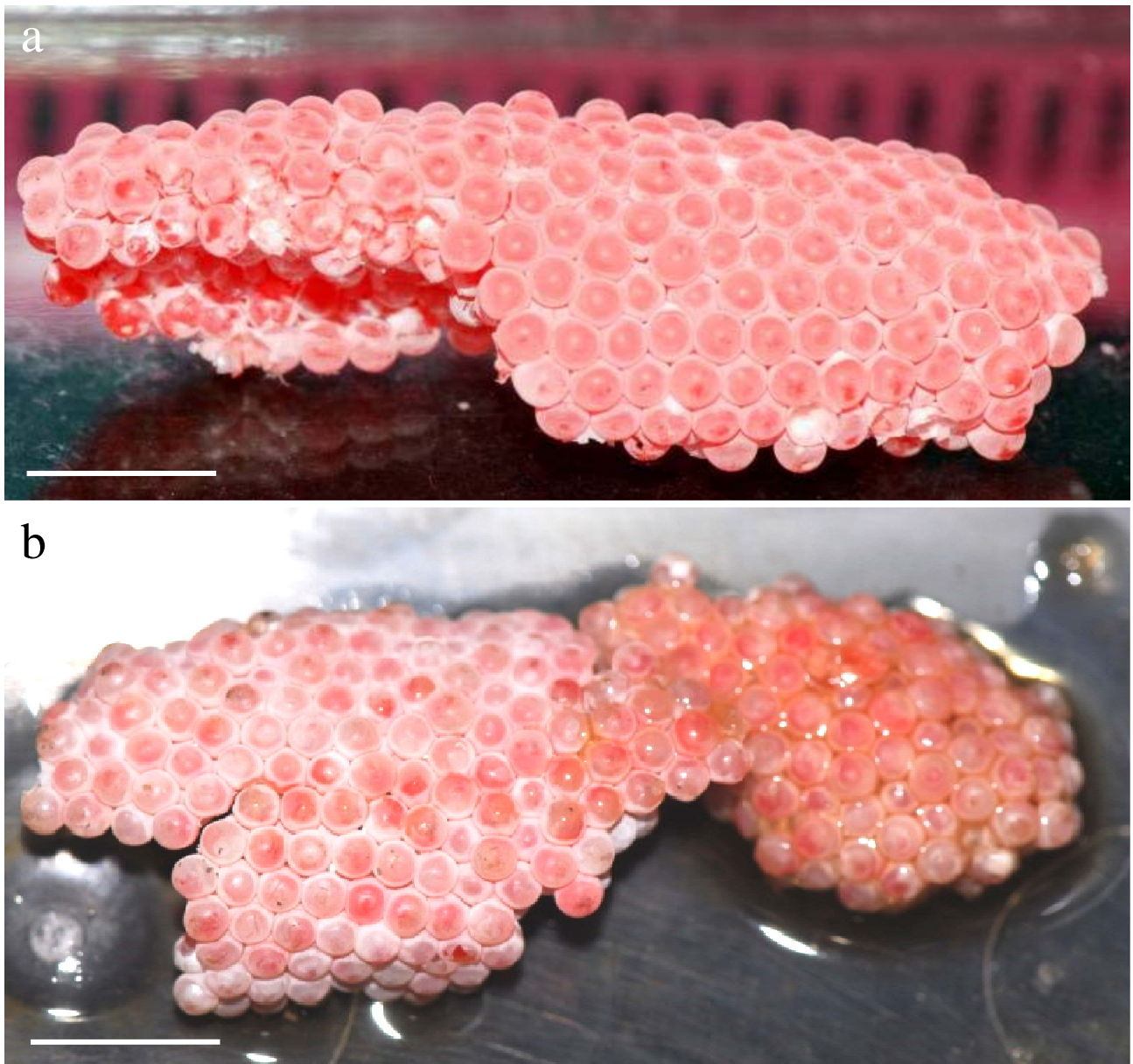


Fig. 5. Egg cluster placed in tank with *Achatina fulica* at start of observation period (a). Same egg cluster after seven days (b). All scale bars = 10 mm.

*Pomacea canaliculata* eggs, alternative food was not provided, but the experiment clearly showed that *Quantula striata* fed readily on the eggs.

Gastropods are limited by their slow pace of locomotion and hence adopt ‘generalised feeding’, which is influenced by the palatability and availability of food (Speiser, 2001). Monocotyledonous plants constitute most of the diet of many land snails including *Bradybaena similaris* which inspired this study. Kranji Reservoir Park is primarily a garden habitat with abundant grass, thus the feeding event witnessed did not occur because of a lack of suitable plant food within the general habitat. Short-term accessibility could have resulted in the mollusc choosing to feed on the eggs since it was moving over granite rocks, which were devoid of grass. Unfortunately, we were unable to obtain *Bradybaena similaris* for this study, and whether this species is capable of mechanically destroying the egg shells to feed or simply feeding opportunistically on eggs that have been broken prior to the feeding remain unclear.

Although the eggs of *Pomacea canaliculata* contain anti-predatory properties (Dreon et al., 2010), the effects on invertebrates such as molluscs are unclear. Adult apple snails readily cannibalise eggs of their own kind (Horn et al., 2008), apparently without ill effects. Gastropods are known to eat a small amount of a new food item, and would not eat it again if the food is not nutritional or toxic (Speiser, 2001). This could have been the case for the *Achatina fulica* individual, which hardly ate any eggs after the initial attempt which we presume to be a palatability test. The continuing ingestion of the eggs by *Quantula striata* to the end of the experiment suggests that it was not being affected by the anti-predatory characteristics of the eggs.



The results suggest that some land snail species, such as *Quantula striata* and possibly, *Bradybaena similaris*, are capable of feeding on the eggs of *Pomacea canaliculata*. There remains the likelihood that anti-digestive properties of the proteins in the eggs or other factors make them repulsive to other snails. It is also possible that *Achatina fulica* did not recognise the eggs as a viable source of food and a clearer understanding would require further study. It would also be imprudent of us to suggest that *Bradybaena similaris*, *Quantula striata*, or any other land snail has the potential to be an effective biological control against the highly invasive *Pomacea canaliculata* based on this preliminary experiment. Present knowledge of the inter-species interactions between these organisms is scant, and more comprehensive studies are needed to shed light on the possibility of such interactions contributing to population control. Nevertheless, observations of land snails feeding on eggs of *Pomacea canaliculata* are hitherto unknown and would be of interest in the manner of possible implications. Hopefully the observations will inspire more in-depth studies.

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