

TERRESTRIAL SNAILS AND SLUGS (MOLLUSCA: GASTROPODA) OF PULAU TEKONG, SINGAPORE

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ABSTRACT. — During recent wildlife surveys on Pulau Tekong, Singapore, opportunities were taken to document the terrestrial malacofauna diversity, which is hitherto unknown. Eleven species were consequently recorded, namely *Semperula* cf. *maculata*, *Semperula* cf. *variegatula*, *Achatina fulica*, *Subulina octona*, *Paropeas achatinaceum*, *Hemiplecta humphreysiana*, *Sarika resplendens*, *Parmarion martensi*, *Quantula striata*, *Bradybaena similis* and *Amphidromus atricallosus temasek*, from the families Veronicellidae, Achatinidae, Subulinidae, Ariophantidae, Dyakiidae, Bradybaenidae and Camaenidae. The records, and photographic evidence, of the terrestrial molluscs occurring on the island are provided in this short note. Notably, *Paropeas achatinaceum* is rediscovered in Singapore after more than a century, and the discovery of sympatrically occurring yellow- and white-shelled forms of *Amphidromus atricallosus temasek* is reported for the first time.

KEY WORDS. — Pulau Tekong, Singapore, mollusc, land snail, land slug

INTRODUCTION

Pulau Tekong is an island situated off northeastern Singapore Island, in the Johor Straits, at the mouth of the Johor River. The island has an area of about 2,400 hectares (National Environment Agency, 2010) and was Singapore's largest island until the creation of Jurong Island (Chou, 2011). It has been inhabited as early as the mid-19th century and once had a population of about 5,000 living in more than a dozen villages (Chen & Lee, 2012). The island is now used exclusively by the Singapore Armed Forces for military purposes and access to the public is restricted.

Sizable natural habitats still exist on Pulau Tekong as it was spared from the past few decades of rapid urbanisation and other development that affected Singapore Island. Wildlife surveys conducted in recent years have revealed Pulau Tekong to be a refuge for many threatened and endangered animals of Singapore such as the leopard cat (*Prionailurus bengalensis*), Malayan porcupine (*Hystrix brachyuran*), and Sunda pangolin (*Manis javanicus*) (Chang, 2006). To date, many mammals, birds, reptiles, and amphibians have been recorded from the island (e.g., Wang & Hails, 2007; Baker & Lim, 2008), but the invertebrate fauna remains largely unknown.

Recent wildlife surveys provided opportunities for us to document the terrestrial molluscan fauna diversity on Pulau Tekong, albeit anecdotally, and provided an interesting first glimpse of the land snail and slug diversity on the island. The 11 species recorded on the surveys are herein reported, with photographic evidence, in this article.

RECORDS AND OBSERVATIONS

Family Veronicellidae

Semperula cf. *maculata* (Templeton, 1858), Fig. 1

This is apparently one of the more common slugs on Pulau Tekong. Foraging individuals were commonly sighted, especially at the reclaimed land at the southern part of the island. A small individual was also found on a camera trap set in a cultivated area at the eastern part of the island.

Semperula cf. *variegatula* (Simroth, 1918), Fig. 2

Only two examples of this species were seen. One observed feeding on faecal matter of a leopard cat (*Prionailurus bengalensis*) in a cultivated area at the eastern part of the island, the other an individual being attacked by ants on the floor of a building.



Fig. 1. *Semperula* cf. *maculata*. Total length c. 5 cm. (Photograph by: Kelvin K. P. Lim).
 Fig. 2. *Semperula* cf. *variegatula*. Total length c. 2.5 cm. (Photograph by: S. K. Tan).

Family Achatinidae

Achatina fulica Bowdich, 1822, Fig. 3

Live animals and empty shells of this species were observed in many parts of Pulau Tekong and it is presumed to be widespread and common. This species is especially common at the reclaimed land at the southern part of the island, although usually hidden from sight amongst plants at the sides of the dirt tracks. It is known to thrive in disturbed human-modified habitats and is not usually common in undisturbed forests (Tan et al., 2012). Originally native to Africa, its occurrence in Singapore was first reported in the early 1920s (Jarrett, 1923). It is presently the largest land snail species in Singapore, occasionally attaining more than 130 mm in shell length (pers. obs.).

Family Subulinidae

Subulina octona (Bruguière, 1789), Fig. 4

Only a single example of this species was found under leaf litter at a forest edge adjacent to a road at Selabin, but it is presumed to be more common and widespread on the island. More examples were probably not observed only because little effort was made to sample the soil and leaf litter thoroughly during the surveys. This tropical cosmopolitan species has been recorded in the Malay Archipelago since the late 1800s (van Benthem Jutting, 1952).

Paropeas achatinaceum (Pfeiffer, 1846), Fig. 5

Several specimens of this smallish species, averaging about 10 mm in shell length, were found in a small damp mossy concrete drain on the eastern end of the island. The observation of this species on the island is noteworthy and may be regarded as a rediscovery of the species in Singapore. Specimens collected more than a century ago from Singapore (H. N. Ridley collection; NHMUK 1896.9.3.33–37) are present in the Natural History Museum, London (see Naggs, 1994), but this species appears to be rare and has not been collected or mentioned by latter workers (e.g., Lim, 1969; Ho, 1995; Tan et al., 2012). However, it is not ascertained if the species is native to Singapore. Owing in part to human activities, this species occurs in the Mascarene Islands, Southeast Asia, Borneo, and has also been introduced to the Hawaiian Islands (van Benthem Jutting, 1952; Cowie, 1997; Vermeulen & Whitten, 1998).



Fig. 3. *Achatina fulica*. Shell length c. 8 cm. (Photograph by: Kelvin K. P. Lim).
 Fig. 4. *Subulina octona*. Shell length: c. 1.5 cm. (Photograph by: Marcus A. H. Chua).
 Fig. 5. *Paropeas achatinaceum*. Shell length c. 1 cm. (Photograph by: S. K. Tan).

Family Ariophantidae

Hemiplecta humphreysiana (Lea, 1840), Fig. 6

This large, native species appears to be rather common and widespread on Pulau Tekong. Most encounters were in the forests and swampy areas, at the northern and central parts of the island. The species is quite widely distributed from Thailand, Malaysia, Singapore to Borneo, and other parts of Indonesia (van Benthem Jutting, 1950), but the taxon is however a species-complex with several distinct forms known. Interestingly, even the population on Pulau Tekong is slightly different in colouration compared to those on Singapore Island despite the close proximity.

Sarika resplendens (Philippi, 1846), Fig. 7

As observed for the species on Singapore Island, this species appears to be more common in modified habitats and is very common with more than two dozen individuals sighted in about half an hour's search at the reclaimed land at the southern part of the island. This species has a varied diet and is known to feed on fresh and rotting vegetable matter as well as scavenging on carrion. A small group was observed scavenging on the remains of a dead frog on one occasion (Tan et al., 2015).

Parmarion martensi Simroth, 1893, Fig. 8

Apparently one of the more common slugs, this species was sighted several times in a few locations around the island. A larger congeneric species *Parmarion pupillaris*, which cannot be reliably distinguished from *Parmarion martensi* by external features, has also been recorded from Singapore (Lim, 1969; Ho, 1995). It is thus possible that more than one species may be present. Most of the specimens encountered were about 50 mm long which, according to van Benthem Jutting (1950), is the normal adult size for *Parmarion martensi*.

Family Dyakiidae

Quantula striata (Gray, 1834), Fig. 9

This commonly seen native snail in Singapore is equally common in forests and in modified habitats. Its shell colour is known to be variable (Tan et al., 2012), but shells of all specimens seen on Pulau Tekong appear to be invariably dark reddish brown. Bioluminescence in this species was first discovered in Singapore by Haneda (1946), and it remains the only bioluminescent terrestrial snail known to date.

Family Bradybaenidae

Bradybaena similaris (Rang, 1831), Fig. 10

Only a few live individuals were found at Salabin, while one live snail and several empty shells were seen amongst vegetation in the reclaimed land. It is commonly found in both forests and urban areas on Singapore Island (Tan et al., 2012), hence is probably more common than our observations suggest. This species is an agricultural pest that has been introduced to the tropics and subtropics worldwide (Abbott, 1989; Cowie, 1997), and is believed to an introduced species in Singapore (Tan et al., 2012).

Family Camaenidae

Amphidromus atricallosus temasek Tan, Chan & Panha, 2011, Fig. 11

This local subspecies was sighted, mostly on tree trunks and on leaves, at several locations around the northern half of the island. Based on our observations, it is not rare, and the highest population density of this arboreal snail seems to occur around the Salabin area. This subspecies is known to be enantiomorphic in the coiling of their shells, but not a single sinistral specimen was observed by us on Pulau Tekong (but see Lok & Tan, 2008). Curiously, the Pulau Tekong population comprises animals that bear shells that are either yellow or white, a phenomenon that has not been previously reported for the local subspecies (Tan et al., 2011). A recently discovered population on Pulau Ubin appears to comprise of animals with only white shells (Tan & Xu, 2013).

DISCUSSION

No exhaustive surveys for molluscs were made and the majority of our observations were of foraging animals encountered rather opportunistically during the nocturnal wildlife surveys. It is thus very likely that some species remain undiscovered, and the true extent of terrestrial mollusc diversity on the island may only be fully appreciated by future surveys focusing on the malacofauna.



Fig. 6. *Hemiplecta humphreysiana*. Shell length c. 5 cm. (Photograph by: Kelvin K. P. Lim).



Fig. 7. *Sarika resplendens*. Shell length c. 2 cm. (Photograph by: Kelvin K. P. Lim).



Fig. 8. *Parmarion martensi*. Total length c. 5 cm. (Photograph by: Kelvin K. P. Lim).



Fig. 9. *Quantula striata*. Shell length c. 2.5 cm. (Photograph by: S. K. Tan).



Fig. 10. *Bradybaena similaris*. Shell length c. 1.5 cm. (Photograph by: S. K. Tan).



Fig. 11. *Amphidromus atricallosus temasek* (subadult). Shell length c. 3.5 cm. (Photograph by: Kelvin K. P. Lim).

Incidentally, most of the taxa regarded as native by Tan et al (2012) are generally conspicuously absent in urban settings and cultivated areas Pulau Tekong. Our observations also seem to suggest that many species are unevenly distributed or restricted to certain parts of the island. It is however unclear if this is due to inadequate sampling or the fact that large areas have been extensively cultivated for agriculture in the past (see Chen & Lee, 2012).

At least three veronicellid and five ariophantid slugs have been recorded from Singapore (Tan & Woo, 2010 and references therein), including *Semperula carusi* (Simroth, 1893), a species described from Singapore. However many slug species are very similar in external morphology and reliable identification of these taxa usually requires anatomical examination (van Benthem Jutting, 1952; see also Gomes & Thomé, 2002). Available references and comparative material in the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore are at present inadequate to enable confident determination of the slug species encountered, hence the slug identifications in this article are provisional.

On Singapore Island, the sympatrically occurring *Amphidromus atricallosus temasek* and *Hemiplecta humphreysiana* are restricted to relatively undisturbed forests around the Central Catchment Nature Reserve, and the Western Catchment Area (Chua & Tan, 2015; Tan & Chua, 2015). It is thus heartening to record these species, which are vulnerable to habitat loss in Singapore, on Pulau Tekong, and apparently in good numbers. However it should also be noted that native terrestrial gastropod diversity in the forests on Pulau Tekong is lower compared to the better quality forests of Singapore Island because many other forest dwelling species (e.g., *Cyclophorus perdix aquila*, *Dyakia kintana*, *Geotrochus lychnia*, *Videna bicolor*) were not recorded, or at least not yet. Therefore although the island may serve as a refuge for certain imperilled or vulnerable terrestrial mollusc species, its importance for the conservation of native mollusc species would require further study to ascertain.

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