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DISCOVERY OF ANOTHER SUBSPECIES OF *AMPHIDROMUS ATRICALLOSUS* (MOLLUSCA: GASTROPODA: CAMAENIDAE) IN SINGAPORE

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ABSTRACT. — A population of the tree snail, *Amphidromus atricallosus perakensis* was recently discovered near Lower Seletar Reservoir in the north-eastern part of Singapore Island. The find represents the first confirmed record of this subspecies in Singapore where it is believed to be non-native.

KEY WORDS. — Singapore, Gastropoda, Camaenidae, *Amphidromus*, *atricallosus*, subspecies

INTRODUCTION

The Camaenidae is one of the largest and most diverse terrestrial mollusc families, but until now the classification of the Camaenidae sensu stricto remains contentious (see Schileyko, 2003; Bouchet & Rocroi, 2005). Within the family, *Amphidromus* Albers (1850), a predominantly Southeast Asian camaenid genus, is well known and most unusual among snails, for having seemingly random enantiomorphism (with shells that coil either dextrally or sinistrally) amongst populations of many species (Sutcharit & Panha, 2006; Sutcharit et al., 2007).

At least six species and subspecies of the genus *Amphidromus* have been reported from Singapore (e.g., Laidlaw & Solem, 1961; Lim, 1969; Ho, 1995; Chan, 1996; Maassen, 2001; Lok & Tan, 2008; Tan & Woo, 2010; Tan et al., 2012), although several require verification. In Feb.2012, we were alerted to the presence of a previously undocumented population of *Amphidromus* snails in a patch of scrubby woodland near Lower Seletar Reservoir. This noteworthy discovery is herein reported.

MATERIAL AND METHODS

Surveys for the snail were carried out in the general location beyond the initial site of discovery to determine its extent of distribution. Each survey site was searched thoroughly for at least an hour, concentrating firstly on the ground for empty shells and fragments, and then looking in trees for live individuals. Most of the specimens collected were of empty shells found on the ground, and have been deposited as voucher specimens in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR) at the National University of Singapore. Abbreviations mentioned are: SH = shell height; SW = shell width; D = dextral; S = sinistral. Shell height is measured from the apex to the lowest part of the outer lip parallel to the coiling axis, and shell width is measured at the widest part of the body whorl (including the lip) perpendicular to the coiling axis. All measurements are in mm. Shells without a thickened outer lip, regardless of their sizes, were treated as juveniles (juv.) and were not measured.

RECORDS AND OBSERVATIONS

Amphidromus (*Amphidromus*) *atricallosus perakensis* Fulton, 1901
(Figs. 1–4)

Material examined. — Singapore, scrubland/secondary forest near Lower Seletar Reservoir, on ground and in trees: 28 S (smallest SH 30 × SW 23.4; largest SH 49.1 × SW 25.1), 22 S (juv.), 1 D (SH 43.7 × SW 24.4), 5 D (juv.) (ZRC.MOL.3077; ZRC.MOL.3078), coll. S. Y. Chan et al., Mar.–Apr.2012; 7 S (smallest SH 41.3 × SW 23.7; largest SH 48.6 × SW 27.2), 2 S (juv.) (ZRC.MOL.3079; ZRC.MOL.3080), coll. K. K. P. Lim, T. H. Ng, H. H. Tan & S. K. Tan, 4 May 2012.

Remarks. — Based on our observations, the population appears to be thriving. Live adult and juvenile snails of various sizes were located on most surveys. Empty shells and fragments were also very common and littered the ground at a

few spots. Sinistral shells dominate the population with dextral specimens making up only about 9% of the material examined.

Shell colouration in this population ranges from sulphur yellow to white, but most specimens are a very pale yellow (Fig. 1). Although the occurrence of white shells among 'normal' yellow-shelled populations is not unusual, it is interesting to note that the presence of white forms has created problems in the past. For a long time, there was much uncertainty regarding the identity and validity of *Amphidromus mundus* (Pfeiffer, 1853), a white-shelled species (e.g., Laidlaw & Solem, 1961; Chan, 1996). The taxon was only recently fixed with a neotype designation and re-description by Sutcharit & Panha (2011).

Interestingly, the majority of smaller juveniles examined (less than 25 mm SH) bear two brown bands, one just below the periphery, the other encircling the columella (Figs. 2, 3). The bands are still present in some larger juveniles (>SH 30) and terminate abruptly following further increase in size. Nevertheless the bands are still detectable in many larger and fully grown individuals, as dark lines at the suture of earlier whorls. Similar dark bands have been observed in some *Amphidromus atricallosus perakensis* shells from Perak, Malaysia and congeners (see Tan et al., 2011; Sutcharit & Panha, 2006), but have not been observed in juveniles of *Amphidromus atricallosus temasek* thus far. However, the significance or taxonomic value of bands in juvenile shells is still unknown as this character is variable, and there is still insufficient material from throughout the entire distribution range for comparison.

Amphidromus atricallosus perakensis can be differentiated from *Amphidromus atricallosus temasek* morphologically by the thickened columellar plait and relatively thicker and longer shell, and animal colouration (see Figs. 4, 5; see also Tan et al., 2011). Tan et al. (2011) mentioned populations with distinct shell characteristics and soft body colouration of *Amphidromus atricallosus perakensis* in a few Peninsular Malaysian localities suggesting a species or subspecies complex. However, we consider it prudent to regard these forms broadly as *Amphidromus atricallosus perakensis* pending additional studies. Furthermore a detailed taxonomic treatment would require much further study and collection, and is beyond the scope of this short note.

Altogether, five snail species were recovered at the locality. Besides *Amphidromus atricallosus perakensis*, they are *Achatina fulica* Bowdich, *Helicarion perfragilis* (von Möllendorff), *Parmarion martensi* Simroth, and *Quantula striata* (Gray). The other four are regarded, respectively, as introduced, of unknown status, and natives by Tan et al. (2012). All four are common species that can be found in nurseries, gardens, and urban areas. No native snail species that are restricted to the forests, such as *Cyclophorus perdix aquila* (Sowerby) and *Hemiplecta humphreysiana* (Lea), were noted.

Fig. 1. Shell colour of *Amphidromus atricallosus perakensis* from Singapore, varies from sulphur yellow (left) to white (middle). A pale yellow dextral specimen on the right, from the same population, is shown for comparison. Left to right, in mm: SH 46 × SW 26.1, SH 49 × SW 25.3 (ZRC.MOL.3077), and SH 43.7 × SW 24.4 (ZRC.MOL.3078). (Photograph by: Tan Siong Kiat).

Fig. 2. *Amphidromus atricallosus perakensis* (ZRC.MOL.3077), growth series (SH 18.5 × SW 14.5 to SH 48 × SW 25.7, in mm). The majority (but not all) of juvenile specimens are banded. (Photograph by: Tan Siong Kiat).

Fig. 3. A juvenile (ZRC.MOL.3079), SH 19.6 × SW 15.1 mm, in situ, roosting under a *Leea indica* leaf. (Photograph by: Tan Heok Hui).

Fig. 4. A full-grown adult (ZRC.MOL.3078), SH 47.1 × SW 25.7 mm, from Singapore. (Photograph by: Tan Heok Hui).

Fig. 5. *Amphidromus atricallosus temasek* (ZRC.MOL.3058), SH 44 × SD 25.6 mm, from the Nee Soon Swamp Forest, Singapore, for comparison. (Photograph by: Tan Heok Hui).

DISCUSSION

Five subspecies of the *Amphidromus atricallosus* group with distinct shell characters and geographic distribution are currently recognised (Tan et al., 2011; see also Sutcharit & Panha, 2006). Although the occurrence of *Amphidromus atricallosus perakensis* in Singapore is often mentioned in the literature, these are actually referable to *Amphidromus atricallosus temasek* (see Tan et al., 2011 and references therein). Regrettably the *Amphidromus* specimens from Seletar mentioned in Hanitsch (1908), and supposedly in the RMBR collection, could not be located. There are a few lots of *Amphidromus atricallosus temasek* shells unaccompanied by locality data or any information that could possibly be Hanitsch's old Seletar material in the ZRC, but confirmation is impossible. There is hitherto no confirmed record of *Amphidromus atricallosus perakensis* in Singapore, and its current known distribution is restricted to Peninsular Malaysia (Sutcharit & Panha, 2006; Tan et al., 2011). This is therefore the first confirmed record of this subspecies in Singapore.

The population of *Amphidromus atricallosus perakensis* near the Lower Seletar Reservoir is believed to be introduced. An establishment could have occurred within a decade to even several decades ago. Old maps showed the area to be occupied by a village as long ago as 1911, and the area has been significantly developed and redeveloped since. A map in Gaw (1971) detailing land use in Singapore indicated extensive plantations in the area. The construction of Lower Seletar Reservoir in the 1980s would also have effected alteration of the surrounding habitats and vegetation types. Unfortunately there is little available information on the origins and other details of cultivated crops in Singapore so the likely origin of this newfound population remains a mystery. It is however not difficult to imagine that these arboreal snails could have hitchhiked their way among plants imported from Peninsular Malaysia. Additionally, the eggs of *Amphidromus* species are typically laid among foliage, in a nest of glued leaves, with each clutch consisting of 100 to more than 200 eggs (Sutcharit & Panha, 2006). Thus an establishment could occur with just one or a few successful hatchings, especially in a suitable yet confined habitat.

No member of the genus *Amphidromus* has previously been incriminated as agricultural pests or invasives, and there is no evidence that these snails could cause harm to local flora or fauna. Presently the population appears restricted to a relatively small area—the roads for motor vehicles at the boundaries possibly acting as an effective barrier preventing dispersal. However, because this population is situated just a few kilometres from Nee Soon Swamp Forest, the presence of another subspecies of the *Amphidromus atricallosus* group is cause for concern. In the scenario that they are somehow transplanted, *Amphidromus atricallosus perakensis* could threaten the endemic subspecies as direct competitors or by interbreeding with the native subspecies to alter unique native genotypes.

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