NATURE IN SINGAPORE 2009 **2**: 467–473
Date of Publication: 17 December 2009

THE IDENTITY OF A MOUSEDEER (MAMMALIA: ARTIODACTYLA: TRAGULIDAE) OBSERVED AT LOWER PEIRCE FOREST, SINGAPORE

Celine H. S. Low[1], **Chan Kwok Wai**[2] and **Kelvin K. P. Lim**[3]*
[1]*Vertebrate Study Group, Nature Society (Singapore), 510 Geylang Road, #02-05 The Sunflower, Singapore 389466, Republic of Singapore*
[2]*Media Tek Singapore Pte. Ltd., 20 Ayer Rajah Crescent, #04-01, Singapore 139964, Republic of Singapore*
[3]*Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore 6Science Drive 2, Blk S6, #03-01, Singapore 117546, Republic of Singapore*
*(*Corresponding author: dbslimkp@nus.edu.sg)*

INTRODUCTION

Asian mousedeer of the genus *Tragulus* were last reviewed by Meijaard & Groves (2004) using craniometrical analyses. They recognise six species in three groups: the *Tragulus napu* group with *Tragulus napu* (Geoffroy & Cuvier), consisting of at least eight subspecies distributed in the Malay Peninsula, Borneo, Sumatra, and adjacent islands; and *Tragulus nigricans* Thomas, (Balabac Island in the southern Philippines); the *Tragulus versicolor* group with *Tragulus versicolor* Thomas, (southern Vietnam); and the *Tragulus javanicus* group with *Tragulus javanicus* (Osbeck), (confined to Java), *Tragulus kanchil* (Raffles), with at least 16 subspecies distributed in mainland Southeast Asia, Borneo, Sumatra, and adjacent islands; and *Tragulus williamsoni* Kloss, (northern Thailand and southernmost China).

In Singapore, two sympatric species are known. The kanchil or pelandok, *Tragulus kanchil* (Raffles), is the smaller of the two. It was referred to in earlier literature as *Tragulus javanicus* (non-Osbeck; see Corbet & Hill, 1992: 251), *Tragulus fulviventer* (see Chasen, 1924: 86), *Tragulus javanicus kanchil* (see Harrison, 1974: 284) and *Tragulus javanicus fulviventer* (see Medway, 1983: 106; Yang et al., 1990: 16). *Tragulus kanchil fulviventer* (Gray), is the subspecies described from Singapore. The napu, *Tragulus napu* (Geoffroy & Cuvier), is the larger. The nominate subspecies (*Tragulus napu napu*) inhabits Singapore.

In the collection of the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research (RMBR) at the National University of Singapore (NUS), there is a specimen of the kanchil from Changi, Singapore, collected in 1912 (ZRC 4.4824), and three specimens of the napu—one each from Changi in 1908 (ZRC 4.4732), Kranji in 1923 (ZRC 4.4749), and Pulau Ubin in 1921 (ZRC 4.4750). In the 1920s, mousedeer were said to be fairly common in Singapore and on some of the outlying islands. In the early morning, they could sometimes be glimpsed on the public paths of the Botanic Gardens (Anonymous, 1923: 20,21; Chasen, 1924: 86).

While mousedeer are still extant in Singapore, they have disappeared from Kranji and the Botanic Gardens. The kanchil lives on in Singapore Island exclusively in the Bukit Timah Nature Reserve and Central Catchment Nature Reserve where individuals are occasionally observed in forests at Bukit Timah, MacRitchie Reservoir, Lower Peirce Reservoir and Nee Soon Swamp Forest (Baker, 2005: 2–3 as *Tragulus javanicus*; Teo & Rajathurai, 1997: 370 as *Tragulus javanicus fulviventer*), but the napu was thought to be locally extinct (Baker & Lim, 2008: 155) until it was rediscovered on Pulau Ubin during a faunal survey of the island between Sep.2008 and Mar.2009 (Kwok, 2009: P8; Ang, 2009: B8; Chua et al., 2009: 374).

Ten years before, two attempts were made by the Singapore Zoo and the National Parks Board (NParks) to re-introduce the napu in Singapore with surplus captive-bred stock from the Singapore Zoo. One group of seven was released into the grounds of the Night Safari at the end of Mandai Lake Road in Jul.1998 in conjunction with the Zoo's 25th Anniversary celebrations. Another group of seven (two males and five females) was released into an area on the northwestern shore of the MacRitchie Reservoir in the Central Catchment Nature Reserve on 26 Apr.1999. Two individuals were sighted about 1 km from the second release site by an NParks ranger about one month later. Since then, there has been no subsequent sighting of these animals, and no sustained effort had been made to look for them (Francis Lim, pers. comm.; Ang, 2009: B8).

The forest adjacent to Lower Peirce Reservoir Park along Old Upper Thomson Road, that forms part of the Central Catchment Nature Reserve, has been a good location to observe mousedeer. Despite the heavy human traffic in the area, the activities of human visitors are largely confined to the system of elevated boardwalks, and this could have disturbed the animals less than if humans were to step directly on the forest floor. We believe that this could be a

Fig. 1. Male *Tragulus kanchil* with five neck stripes from Lower Peirce forest. The animal on the left was photographed on 14 Jun.2008 and is apparently the same individual as those in the centre and right images photographed on 21 Feb.2009. [Photographs by: Chan Kwok Wai (left); Foo Sai Khoon (right)].

reason for the higher incidence of kanchil being sighted and photographed there. However, owing to the apparent tameness of the mousedeer photographed at Lower Peirce Reservoir forest, it is also possible that the animals observed there in relative close proximity were former captive individuals abandoned by people.

Recently, an adult male (tusk-bearing) mousedeer photographed at the Lower Peirce boardwalk has been identified as a napu, and said to be the descendant of the seven individuals released in the Central Catchment Nature Reserve in 1999 (Ang, 2009: B8). We disagree, as we deduce that the specimen to be a kanchil instead. Our diagnosis is discussed in this article.

OBSERVATIONS

The mousedeer in question appears on images taken at the Lower Peirce Reservoir boardwalk on 14 Jun.2008 by Chan Kwok Wai (Fig. 1, left), and again on 19 Feb.2009 by K. C. Tsang (not illustrated) and 21 Feb.2009 by Foo Sai Khoon (Fig. 1, centre and right). All the photographs appear to be of the same individual. Apart from 14 Jun.2008, when it was photographed in the night, the other images were recorded in the afternoon. Based on the throat markings alone, this individual is identifiable as a napu.

DISCUSSION

The napu and the kanchil can be distinguished on the basis of adult size: in shoulder height, *Tragulus napu* generally stands at 300–350 mm, while *Tragulus kanchil* stands at 200–230 mm (Francis, 2008: 315, 316). However, it is not possible to accurately determine the size of the animal from photographs in the absence of scale markers. Also subadult napu are equivalent in size to fully-grown kanchil. Hence, we are of the opinion that coat colouration should be taken into account when attempting to identify mousedeer in the field.

The coat colour of the napu has been referred to as ‘usually smoky grey’ (Anonymous, 1923: 21), ‘greyish’ (Chasen, 1924: 86), and ‘greyish brown with black markings on the head and back’ (Harrison, 1974: 283, 284). Taking the various subspecies into consideration, Francis (2008: 317) describes *Tragulus napu* as mottled orange-buff, grey-buff and blackish on the upperparts, darker in midline and paler on the sides of the body, and often with darker nape patch; underparts white and usually without brown stripes on the belly. From the napu skins we have examined at the Raffles Museum, the dark stripe on the ventrum is often present, although mostly very narrow and indistinct, and rarely bisects the white belly (see Fig. 3 left & centre and 5). All the animals photographed on Pulau Ubin have yellowish-brown

Fig. 2. *Tragulus kanchil* with three neck stripes from Lower Peirce Reservoir forest, apparently of three different individuals. Left: female photographed on 17 Mar.2009. Centre: Male photographed on 19 Mar.2005. Right: Female photographed on 9 Jan.2005. [Photographs by: Nick Baker (left); Norman Lim (centre); Chan Kwok Wai (right)].

coats without contrasting black ears and limbs. They fit the descriptions for *Tragulus napu napu* (with reference to specimens ZRC 4.4732, ZRC 4.4749 and ZRC 4.4750).

We have found that the blackish marking on the nape is not useful for distinguishing mousedeer species. At the Raffles Museum, all the kanchil skins we have examined have a broad blackish stripe that runs from the top of the head and down the nape. On the napu, this dark nape stripe is also present on many individuals, but indistinct or absent on a few (see Fig. 3, right).

According to Francis Lim (pers. comm.) who was involved in the selection and conditioning of animals used for the re-introduction programmes, the napu were from the Singapore Zoo's captive-bred stock. These animals have bright reddish-orange coats with a large amount of black hair on the back. The lower limbs, ears and nose are also black, and there is a black stripe across the eye from snout to ear and another black stripe along the upper lip (Fig. 3, right). They appear to belong to the form that occurs on the small Sunda islands, that has high levels of black and red on parts of the fur. As such, they are likely to be *Tragulus napu rufulus* Miller (as defined by Meijaard & Groves, 2004: 69; Yong, 1973: 172), the subspecies that is found on Pulau Tioman and various islands of the Riau Archipelago, including Pulau Batam and Pulau Bintan. The form that occurs on mainland Malay Peninsula, Sumatra and Borneo, the nominate subspecies *Tragulus napu napu*, generally has a dull, yellowish-brown coat (see Meijaard & Groves, 2004: 69, 98). The animals observed recently on Pulau Ubin (Fig. 3, left and centre) are clearly of the mainland variety.

In comparison, the pelage of the kanchil is 'more often than not of a rufous colour' (Anonymous, 1923: 21), 'brownish colour' (Chasen, 1924: 86) or 'more reddish brown' (Harrison, 1974: 284, 285). Francis (2008: 316) describes *Tragulus kanchil* as being a relatively uniform reddish brown finely speckled with black, the midline of the nape usually blacker than the rest of the back and often forms a distinct dark stripe; underparts white with variable brown stripes up the middle, or along sides of belly. We have noted that on *Tragulus kanchil fulviventer*, the brown mid-ventral stripe, although variable in width, is always distinct and fully bisects the white underside (Figs. 2, 4).

The mousedeer in question here is brown instead of orange or grey-buff, and lacks the black colouration on the lower limbs, nose, ears, and the black eye-stripe. There is a very distinct broad brown stripe in the middle of the underside that runs all the way up the chest, dividing the white ventrum (Fig. 1). It thus fits the colouration of the kanchil, and excludes the possibility of the animal being a descendant of the introduced napu.

The brown and white markings on the throat and upper chest are regularly cited as a diagnostic character to differentiate the napu from the kanchil. In the napu, this has been described as 'a white stripe along each side of the throat which is broken or deflected in the centre' (Anonymous, 1923: 21; Chasen, 1924: 86), "an irregular white line on each side of the

Fig. 3. Left and centre: *Tragulus napu napu* from Pulau Ubin, with views of the neck and chest colour pattern, photographed on 22 Feb.2009 and 30 Jan.2009, respectively. Right: *Tragulus napu rufulus*, example of the stock kept and bred at the Singapore Zoo. Note the black extremities, lack of black nape stripe and bright reddish coat. [Photographs by: Chan Kwok Wai (left); Celine Low (centre); Kelvin K. P. Lim (right)].

throat" (Harrison, 1974: 283). Corbet & Hill (1992: 250, fig, 20b) describe the feature as 'a projection of dorsal colour n each side interrupted the smooth upper edge of the white line from nape to lower lip'. Francis (2008: 317) describes it as a pattern of brown and white markings on the upper chest and underside of neck, typically consisting of a triangular white stripe in the centre bordered by dark brown stripes, then two separate diagonal white stripes on each side, one originating near the front of the chin, and one in the middle of the throat, though sometimes the two merge. In side profile this usually appears as two separate white stripes on the side of the neck.

In the kanchil, the white outer throat stripe runs unbroken and straight from the jaw and along the side of the throat to the shoulder (Anonymous, 1923: 21; Chasen, 1924: 86; Harrison, 1974: 284). According to Francis (2008: 316), the throat markings typically consist of the triangular white stripe up the middle, bordered by dark brown stripe, then one white diagonal stripe on each side usually joining on chin. In side profile, this appears as a single white line from chin to side of chest. Also see illustration in Corbet & Hill (1992: 250, Fig. 20a as *Tragulus javanicus*).

While throat markings are reliable in most cases, there are notable exceptions at least with *Tragulus kanchil*. This is illustrated clearly in the specimen, ZRC 4.4823 (Fig. 4), as well as the 'napu' from Lower Peirce (Fig. 1). The white stripe that runs from the chin to the side is interrupted by a narrow wedge of brown or smudged with brown similar to that of the napu's. Despite the throat markings, both animals exhibit the fairly uniform reddish brown upperparts and the distinct brown stripe on the underside. This shows that, important though the throat markings are, they are not exclusive to all individuals, at least for the kanchil, and should not be considered as the sole diagnostic character for distinguishing kanchil from napu.

CONCLUSION

The napu and the kanchil are usually distinguished from each other by the number of white stripes on their throat and neck. However, in rare cases, this does not hold true at least for the kanchil. When coat colour and dark mid-ventral stripe are taken into consideration, the mousedeer from Lower Peirce, thought to be a napu, *Tragulus napu*, should be a kanchil, *Tragulus kanchil fulviventer*. Therefore, there is no recent record of wild napu on Singapore Island.

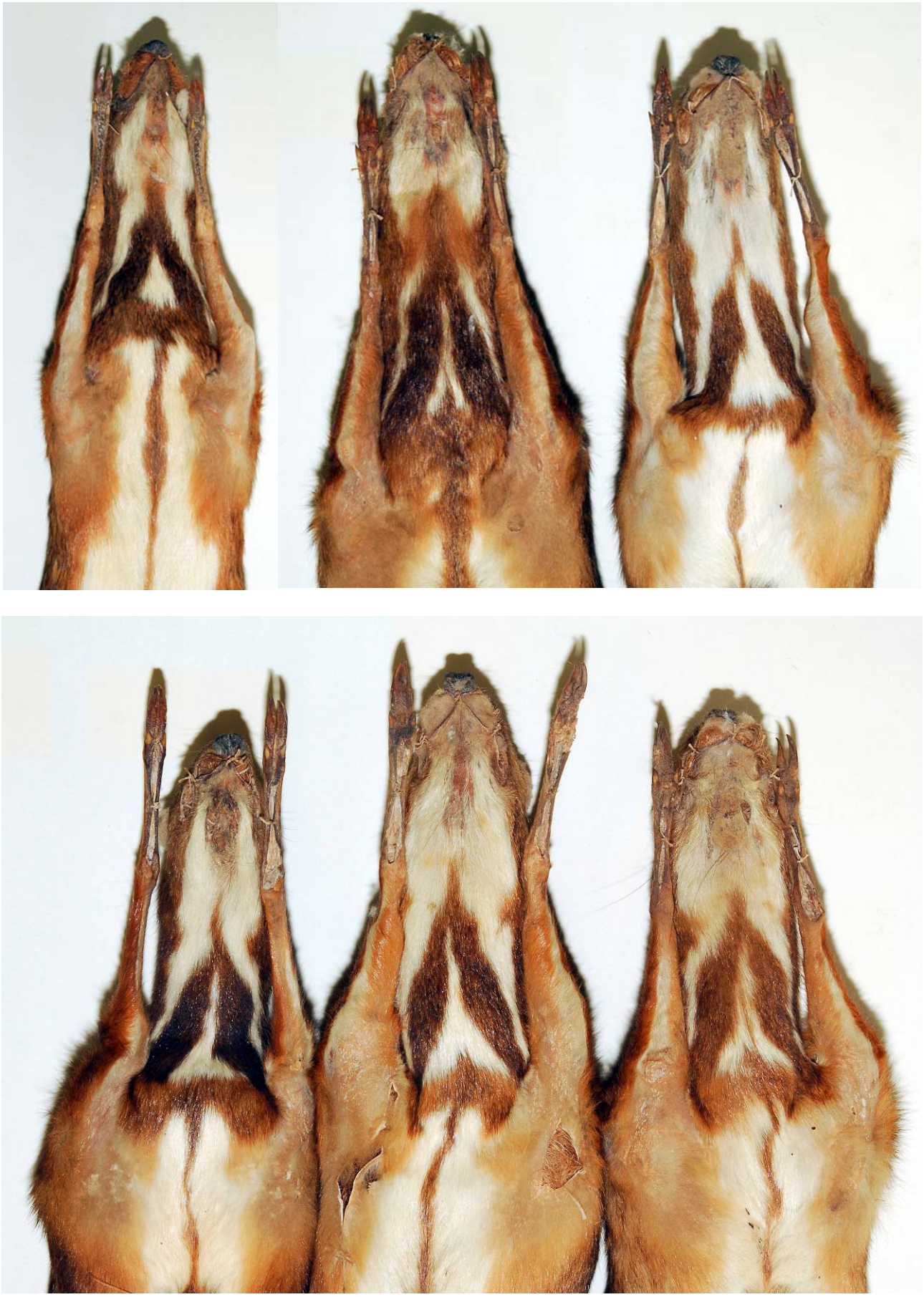

Fig. 4. *Tragulus kanchil fulviventer*, views of throat and chest. Top row (left to right): ZRC 4.4824 from Changi, Singapore; ZRC 4.4823 and ZRC 4.4822 from Johore, Malaysia. Bottom row (left to right): ZRC 4.4817, ZRC 4.4814, ZRC 4.4818 from Johore, Malaysia.

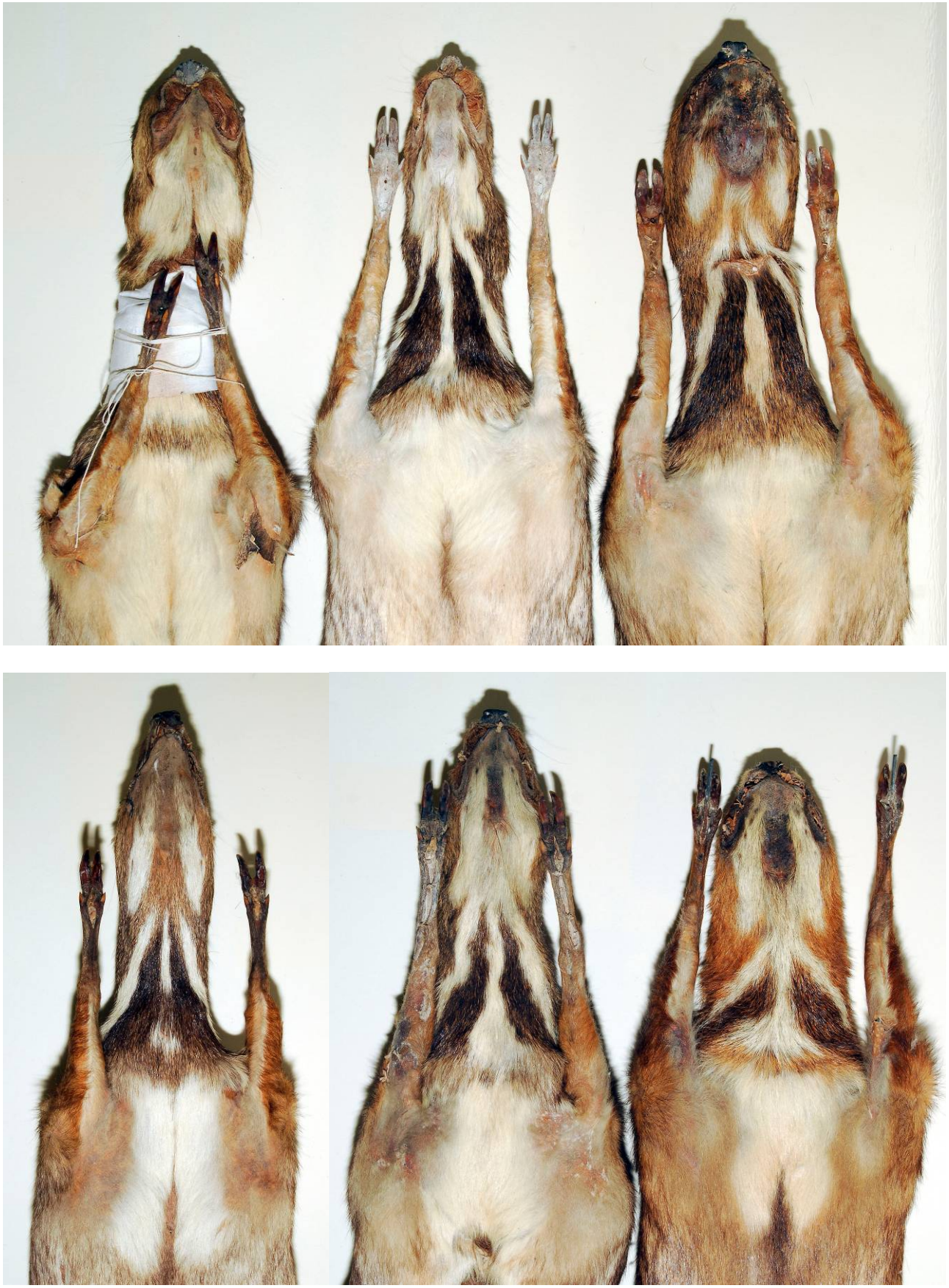

Fig. 5. *Tragulus napu*, views of throat and chest. Top row (left to right): *Tragulus napu napu* — ZRC 4.4732 from Changi, Singapore; ZRC 4.4749 from Kranji, Singapore; ZRC 4.4750 from Pulau Ubin, Singapore. Bottom row (left to right): *Tragulus napu napu* — ZRC 4.4729 from Kuala Lumpur, Malaysia; ZRC 4.4823 from Johore, Malaysia; *Tragulus napu rufulus* — ZRC 4.4822 from Pulau Bintan, Indonesia.

COMPARATIVE MATERIAL

Specimens bearing catalogue numbers with the ZRC prefix are skins from the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), Department of Biological Sciences, National University of Singapore (NUS).

Tragulus kanchil photographs from Lower Peirce Reservoir forest, Singapore: Female on 9 Jan.2005 by Chan Kwok Wai (Fig. 2, right); male on 19 Mar.2005 by Norman Lim (Fig. 2, centre); female on 17 Mar.2009 by Nick Baker (Fig. 2, left).

Tragulus kanchil fulviventer specimens: ZRC 4.4824, one example from Changi, Singapore, collected in 1912 (Fig. 4, top left); ZRC 4.4814 (Fig. 4, bottom centre), ZRC 4.4817 (Fig. 4, bottom left), ZRC 4.4818 (Fig. 4, bottom right), ZRC 4.4822 (Fig. 4, top right), ZRC 4.4823 (Fig. 4, top centre), five examples from Johor, Malaysia, collected in 1912.

Tragulus napu napu photographs from Pulau Ubin, Singapore: One example on 30 Jan.2009, by Celine Low (Fig. 3, centre); one example on 22 Feb.2009 by Chan Kwok Wai (Fig. 3, left).

Tragulus napu napu specimens: ZRC 4.4732, one example from Changi, Singapore, collected in 1908 (Fig. 5, top left); ZRC 4.4749, one example from Kranji, Singapore, collected in 1923 (Fig. 5, top centre); ZRC 4.4750, one example from Pulau Ubin, Singapore, collected in 1921 (Fig. 5, top right); ZRC 4.4751, one example from Johor, Malaysia, collected in 1912 (Fig. 5, bottom centre); ZRC 4.4729, one example from Kuala Lumpur, Malaysia, collected in 1906 (Fig. 5, bottom left).

Tragulus napu rufulus specimens: ZRC 4.4745, one example from Pulau Bintan of the Riau Archipelago, Indonesia, collected in 1924 (Fig. 5, bottom right).

Tragulus napu rufulus photograph: one captive example at the Singapore Zoo by Kelvin K. P. Lim (Fig. 3, right).

ACKNOWLEDGEMENTS

We are most grateful to Foo Sai Khoon, Nick Baker, and Norman Lim who generously permitted us to publish their photographs of mousedeer in this article. We thank R. Subaraj for some useful nuggets of information, and Francis Lim of the Singapore Zoo for kindly furnishing us with some details on the mousedeer re-introduction programme.

LITERATURE CITED

Ang Y., 2009. Greater mousedeer sighted in Ubin. *The Straits Times*, 26 Mar.2009, p. B8.

Anonymous, 1923. Meeting. April 10th, 1922. Exhibitions. Malayan mouse-deer. *The Singapore Naturalist*. **2**: 20–21.

Baker, N., 2005. Our forest residents. *Nature Watch*, **13**(3): 2–9.

Baker, N. & K. K. P. Lim, 2008. *Wild Animals of Singapore. A Photographic Guide to Mammals, Reptiles, Amphibians and Freshwater Fishes*. Draco Publishing and Distribution Pte. Ltd. and Nature Society (Singapore). 180 pp.

Chasen, F. N., 1924. A preliminary account of the mammals of Singapore Island. *The Singapore Naturalist*, **3**: 76–86.

Corbet, G. B. & J. E. Hill, 1992. *The Mammals of the Indomalayan Region: A Systematic Review*. Natural History Museum Publications & Oxford University Press. 488 pp.

Chua, M., Sivasothi, N. & R. Teo, 2009. Rediscovery of greater mouse deer, *Tragulus napu* (Mammalia: Artiodactyla: Tragulidae) in Pulau Ubin, Singapore. *Nature in Singapore*, **2**: 373–378.

Francis, C. M., 2008. *A Field Guide to the Mammals of South-east Asia*. New Holland Publishers (UK) Ltd. 392 pp.

Harrison, J., 1974. *An Introduction to Mammals of Singapore and Malaya*. Second impression. Malayan Nature Society Singapore Branch. xi +340 pp.

Kwok S. T., 2009. Originally extinct locally, rare greater mousedeer reappears on Pulau Ubin. *Lianhe Wanbao*, 26 Mar.2009, p. P8 (in Chinese).

Medway, Lord, 1983. *The Wild Mammals of Malaya (Peninsular Malaysia) and Singapore*. 2nd Edition, reprinted with corrections. Oxford University Press, Kuala Lumpur. xxiii + 131 pp.

Meijaard, E. & C. P. Groves, 2004. A taxonomic revision of the *Tragulus* mouse-deer (Artiodactyla). *Zoological Journal of the Linnean Society*, **140**(1): 63–102, 23 figs.

Payne, J., C. M. Francis & K. Phillipps, 1985. *A Field Guide to the Mammals of Borneo*. The Sabah Society with World Wildlife Fund Malaysia. 332 pp.

Teo, R. C. H. & S. Rajathurai, 1997. Mammals, reptiles and amphibians in the nature reserves of Singapore—diversity, abundance and distribution. *The Gardens' Bulletin, Singapore*, **49**(2): 353–425.

Yang C. M., K. Yong & K. K. P. Lim, 1990. Wild mammals of Singapore. In: Chou L. M. & P. K. L. Ng (eds.), *Essays in Zoology. Papers Commemorating the 40th Anniversary of the Department of Zoology, National University of Singapore*. Pp. 1–23.

Yong H. S., 1973. The mouse-deer of Pulau Tioman. *Malayan Nature Journal*, **26**(3&4): 172–174.