

## NEW LOCALITY RECORDS FOR TWO SPECIES OF FLYING SQUIRRELS (MAMMALIA: RODENTIA: SCIURIDAE) IN SINGAPORE

Marcus A. H. Chua<sup>1,2\*</sup>, Nick Baker<sup>2</sup>, Ron K. H. Yeo and N. Sivasothi<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, National University of Singapore

14 Science Drive 4, Singapore 117543, Republic of Singapore

<sup>2</sup>Vertebrate Study Group, Nature Society (Singapore)

510 Geylang Road, #02-05 The Sunflower, Singapore 398466, Republic of Singapore

(\*Corresponding author: [marcus.chua.ah@gmail.com](mailto:marcus.chua.ah@gmail.com))

**ABSTRACT.** — Singapore is home to two nationally threatened flying squirrel species that were only recently rediscovered or recorded in the 1990s. New locality records are presented for the red-cheeked flying squirrel (*Hylopetes spadiceus*) in the Central Catchment Nature Reserve, and the Horsfield's flying squirrel (*Iomys horsfieldii*) at Bukit Batok Nature Park. These appear to be the results of increased night survey efforts and/or improved survey equipment.

**KEY WORDS.** — *Hylopetes spadiceus*, *Iomys horsfieldii*, distribution, Singapore

### INTRODUCTION

The red-cheeked flying squirrel (*Hylopetes spadiceus*) and Horsfield's flying squirrel (*Iomys horsfieldii*) occur in Singapore (Baker & Lim, 2012). Flying squirrels do not fly but glide between trees, enabled by membranes between their fore and hind limbs. These animals are difficult to see and identify in the field owing to their nocturnal and arboreal habits (Francis, 2008). This may be why they were only rediscovered or recorded for the first time in Singapore in the mid-1990s, and are thought to have restricted local distributions within the Bukit Timah Nature Reserve (BTNR) and Central Catchment Nature Reserve (CCNR; Teo & Rajathurai, 1997). A third species, the distinctly larger red giant flying squirrel (*Petaurista petaurista*), was last seen in the CCNR in 1986 (Yang et al., 1990; Lim et al., 2008) and its present status in Singapore is unknown. In this article, we present new locality records in Singapore for the red-cheeked flying squirrel and the Horsfield's flying squirrel. Notes on distinguishing these two similar-looking species are appended. Identification and nomenclature follow those of Francis (2008).

### RECORDS

**Red-cheeked flying squirrel, *Hylopetes spadiceus* (Blyth).** — The red-cheeked flying squirrel was first discovered in Singapore in Oct.1996 at BTNR, and was thought to be restricted to the reserve (Teo & Rajathurai, 1997). Lim et al. (2008) classified it as a critically endangered species in Singapore, while Baker & Lim (2012) listed it as being restricted to a few areas and rare.

This is the smallest species of flying squirrel found in Singapore. Head-body length ranges from 157–184 mm, while the tail measures 152–166 mm (Francis, 2008). The upperparts are blackish or dark grey-brown, with rust-coloured markings especially along the midline. The underparts are white with an orange tinge over hairs with grey bases. The gliding membrane is blackish with a thin white margin. The leaf- or feather-like tail typical of small flying squirrels is dark, slightly orange-brown with lighter underfur. The base of the tail is tinged orange. Cheeks are orange brown on grey.

In Dec.2010, NB was granted permission by NParks to photograph the occupants of a flying squirrel nest on a silverback (*Rhodamnia cinerea*) tree at night in Nee Soon Swamp Forest located in the CCNR. The entrance to the nest measured 3 cm wide, and 4 cm high, and was located 1.31 m above ground. It was thought to be an active nest as it was plugged with dry grass during the day and unplugged at night.

A portable photographic hide was set up in order to minimise disturbance to the nest by concealing the photographer and photographic equipment. The area was weakly illuminated with red light, and camera pre-flash was avoided.

On 21 Dec.2010, at 2004 hours, a squirrel emerged and briefly rested on the trunk about 50 cm above the entrance hole (Fig. 1). This permitted a single photograph to be taken which confirmed the species as a red-cheeked flying squirrel.

No other squirrel was observed emerging from the nest during the subsequent 30 min. It is not known if additional occupants were present in the nest.

The event on 21 Dec.2010 had been preceded by three earlier unsuccessful attempts made to photograph a squirrel that emerged from the nest. On all occasions, it was noted that the plug of dry grass was removed from the entrance hole at dusk. Typically, a squirrel would emerge rapidly and run to the tree canopy without stopping.

The second observation in the CCNR was recorded by RKHY and MAHC on the night of 6 Mar.2012. An individual was observed perched on a *Syzygium chloranthum* branch and feeding on a fruit in a mature secondary forest area within Chestnut Forest in the CCNR (Fig. 2A). After stripping parts of the outer section, the fruit was discarded and the squirrel descended to the mid-section of the tree trunk momentarily (Fig. 2B). From there it climbed back up to a branch, and made a short glide to another tree, where it was obscured from sight.

**Horsfield's flying squirrel, *Iomys horsfieldii* (Waterhouse).** — Horsfield's flying squirrel was first recorded in Singapore by Chasen (1925) from Kranji and Bukit Timah. Although considered to be the subspecies *Iomys horsfieldii davisoni* based on geographical distribution, Chasen (1940) found that specimens from Singapore were similar to the subspecies *Iomys horsfieldii penangensis* from Penang Island, Malaysia, on the basis of colour, which he described as being “lighter and brighter in colour on the upper parts and tail”. He also noted the Singapore specimens have short tooth rows (8.8 mm) compared to those of Penang (9.8 mm) and mainland Peninsular Malaysia (9.2 mm) and that they “may represent yet another race”. Horsfield's flying squirrel was rediscovered in 1995 in the CCNR after an absence of more than 70 years (Teo & Rajathurai, 1997). Lim et al. (2008) listed the species as being nationally endangered in the 2<sup>nd</sup> edition of the Singapore Red Data Book.



Fig. 1. Red-cheeked flying squirrel (*Hylopetes spadiceus*) climbing up the silverback (*Rhodamnia cinerea*) trunk in Nee Soon Swamp Forest after emerging from the nest hole on 21 Dec.2010. (Photograph by: Nick Baker).



Fig. 2. Red-cheeked flying squirrel at Chestnut Forest on 6 Mar.2012: A, feeding on *Syzygium chloranthum* fruit; B, descending a tree trunk and showing the distinctive blackish gliding membrane with white margins and pale underparts tinged with orange. (Photographs by: Marcus Chua).

Horsfield's flying squirrel is a medium-sized flying squirrel with head-body length of 165–230 mm and a tail length of 160–207 mm. It has brown to dark grey upper parts with buff- or orange-tipped hairs. The underparts are orange-buff or whitish with orange edges. The tail is relatively rounded and rusty brown. The gliding membrane is fringed with rusty brown and the cheeks are buff- or rust-coloured, contrasting with a darker crown (Francis, 2008).

The first observation in Bukit Batok Nature Park (BBNP) by RKHY took place on the night of 17 Sep.2011 when a flying squirrel was seen feeding on a fruit while perched on a branch of a silverback tree (*Rhodamnia cinerea*). The squirrel's identity could not be determined as it was very high up on a tree and moved away before it could be photographed. Subsequent observations were made on 31 Mar.2012, 11 May 2012, and 20 Sep.2012. Photographs taken during the last encounter confirmed the animal as a Horsfield's flying squirrel. These are the first confirmed published records of the species outside the BTNR and CCNR.

During the last encounter on 20 Sep.2012, a Horsfield's flying squirrel at BBNP attempted to glide from one tree to another, but landed short on the ground. A photograph taken by RKHY as it climbed up the tree trunk showed that its tail was injured, having been entangled by a piece of string (Fig. 3).

## DISCUSSION

The detection of these two species of rare and elusive flying squirrel in previously unrecorded localities is not likely to be a result of natural range expansion. This is because the large distances and man-made barriers (e.g., Bukit Timah Expressway and major roads) between these sites and known habitats of the squirrels make natural range expansion unlikely.

It is perhaps more plausible that the two species have remained undetected in the CCNR and BBNP in previous surveys. In the early to mid-1990s, comprehensive vertebrate surveys in forested habitats in Singapore were conducted by local naturalists (Subaraj, 1995; Teo & Rajathurai, 1997). Few comprehensive surveys have been conducted until the present time. Survey efforts and the use of new techniques and equipment (e.g., camera traps, harp traps, improved lighting and camera equipment) have recently resulted in the rediscovery of several vertebrate species in Singapore (Chua et al., 2009; Leong & Lim, 2009; Leong et al., 2009). The new locality records documented here may likewise



Fig. 3. Horsfield's flying squirrel (*Iomys horsfieldii*) with a tail injury photographed in Bukit Batok Nature Park on 20 Sep.2012. (Photograph by: Ron K. H. Yeo).

be a result of improved survey effort and/or photographic equipment. The ability to verify the identity of these squirrels from photographic evidence was certainly important for the records presented in this paper.

Identification of the two species in the field can be challenging, but possible for a keen observer. The smaller red-cheeked flying squirrel can be distinguished from the larger Horsfield's flying squirrel by its gliding membrane with a thin white margin and a dark brown tail with an orange-tinged base. Horsfield's flying squirrel has an orange gliding membrane margin and rusty-brown tail that is more uniformly grizzled along its length. When seen from below, the characteristic uniform orange-tinged underside of Horsfield's flying squirrel sets it apart from the white underside marked with grey and orange of the red-cheeked flying squirrel.

The nest of the red-cheeked flying squirrel is here described for the second time in Singapore after Teo & Rajathurai (1997). The size of the nest hole and location are consistent with those reported by Francis (2008). NB also observed a nest of the red-cheeked flying squirrel in Langkawi, Malaysia, of similar dimensions and height from the ground, which was inhabited by at least three individuals (Baker, 2013).

The presence of the nationally endangered Horsfield's flying squirrel in the forested areas of BBNP highlights the conservation value of secondary forests outside the nature reserves (Lim et al., 2008; Baker & Lim, 2012). Other non-volant mammals that are dependent on forests or wooded habitats known to be present in the forest fragment in BBNP are the internationally endangered Sunda pangolin (*Manis javanica*), Malayan colugo (*Galeopterus variegatus*), slender squirrel (*Sundasciurus tenuis*), and common treeshrew (*Tupaia glis*) (Duckworth et al., 2008; Baker & Lim, 2012). This is consistent with the observation that many of the surviving native mammal species of Singapore are able to live in secondary vegetation (Corlett, 1992). With existing forest reserves reduced to a mere 0.28% of the total land area of Singapore (Corlett, 1992; Yee et al., 2011), forested habitats bordering or present outside these nature reserves are potentially a valuable refuge or buffer area for many native forest-dwelling mammals.

Little else is known about both the red-cheeked flying squirrel and Horsfield's flying squirrel in Singapore. These records highlight the need for consistent field work in Singapore to add to a growing body of knowledge, establish baselines, and detect change. Little is known about the ecology of these and many other forest mammals in Singapore. Hence, studies should be encouraged which will contribute to the management of our limited forest ecosystems.

## CONCLUSIONS

Dedicated nocturnal mammal surveys and observations produced new locality records of the nationally critically endangered red-cheeked flying squirrel in the CCNR and the nationally endangered Horsfield's flying squirrel in BBNP. These records may represent individuals or populations at point locations that were previously undetected but are now more regularly recorded owing to increased night survey effort and/or improved survey equipment.

## ACKNOWLEDGEMENTS

We would like to thank the National Parks Board for permitting us to photograph the flying squirrel nest and survey the CCNR at night (research permit NPRP10-086). We are grateful to Kelvin K. P. Lim, for facilitating access to examine the mammal specimens of the Zoological Reference Collection at the Raffles Museum of Biodiversity Research, and staff of the Singapore Botanic Gardens (SING) Herbarium who helped with plant identifications. MAHC would like to acknowledge the Wildlife Reserves Singapore Conservation Fund for supporting the field surveys as part of the leopard cat ecology and conservation MSc research project at the National University of Singapore. RKHY would like to thank Dillen Ng, Fung Tze Kwan, Xu Weiting, and Soh Hock Heng Junius for accompanying him to BBNP to photograph the flying squirrels.

## LITERATURE CITED

- Baker, N. & K. K. P. Lim, 2012. *Wild Animals of Singapore. A Photographic Guide to Mammals, Reptiles, Amphibians and Freshwater Fishes. Reprint with Correction and Updates*. Draco Publishing and Distribution and Nature Society (Singapore), Singapore. 180 pp.
- Baker, N. 2013. *Red-Cheeked Flying Squirrel*. <http://www.ecologyasia.com/verts/mammals/red-cheeked-flying-squirrel.htm>. (Accessed 23 Jul.2013).
- Chasen, F. N., 1925. A preliminary account of the mammals of Singapore Island. *Singapore Naturalist*, **5**: 74–89.
- Chasen, F. N., 1940. A handlist of Malaysian mammals. *Bulletin of the Raffles Museum*, **15**: 1–229.
- Chua, M., N. Sivasothi & R. Teo, 2009. The rediscovery of the greater mouse deer, *Tragulus napu* (Mammalia: Artiodactyla: Tragulidae) in Pulau Ubin, Singapore. *Nature in Singapore*, **2**: 373–378.
- Corlett, R. T., 1992. The ecological transformation of Singapore, 1819–1990. *Journal of Biogeography*, **19**: 411–420.
- Duckworth, J. W., A. Pattanavibool, P. Newton & Nguyen Van Nhuan, 2008. *Manis javanica*. In: IUCN (ed.), *IUCN Red List of Threatened Species. Version 2013.1*. <http://www.iucnredlist.org/details/12763/0>. (Accessed 23 Jul.2013).
- Francis, C. M., 2008. *A Field Guide to the Mammals of Southeast Asia*. New Holland Publishers, UK. 392 pp.
- Lim, K. K. P., R. Subaraj, S. H. Yeo, N. Lim, D. Lane & B. Y. H. Lee, 2008. Mammals. In: Davison, G. W. H., P. K. L. Ng & H. C. Ho (eds.), *The Singapore Red Data Book: Threatened Plants & Animals of Singapore. 2<sup>nd</sup> Edition*. Nature Society (Singapore), Singapore. Pp. 190–207.
- Leong, T. M. & K. K. P. Lim, 2009. Noteworthy microchiropteran records from the Bukit Timah and Central Catchment Nature Reserves, Singapore. *Nature in Singapore*, **2**: 83–90.
- Leong, T. M., K. K. P. Lim & N. Baker, 2009. Rediscovery of the white-spotted cat snake, *Boiga drapiezii* in Singapore (Reptilia: Serpentes: Colubridae). *Nature in Singapore*, **2**: 487–493.
- Subaraj, R., 1995. A survey of the vertebrate fauna of Pulau Ubin. *The Pangolin*, **8**: 31–36.
- Teo, R. C. H. & S. Rajathurai, 1997. Mammals, reptiles and amphibians in the Nature Reserves of Singapore: Diversity, abundance and distribution. *Gardens' Bulletin Singapore*, **49**: 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*. Department of Zoology, National University of Singapore, Singapore. Pp. 1–23.
- Yee, A. T. K., R. T. Corlett, S. C. Liew & H. T. W. Tan, 2011. The vegetation of Singapore—an updated map. *Gardens' Bulletin Singapore*, **63**: 205–212