

NOTES ON THE COLLECTIONS OF THE SELANGOR PYGMY FLYING SQUIRREL, *Petaurillus Kinlochii* (RODENTIA: *Sciuridae*) IN MALAYSIA.

Cheong Yoon Ling^{1*}, Tan Poai Ean², Heng Pei Pei¹, Mohd Hazilas Mat Hashim¹, Nor Aina Majid¹,
Lim Kuang Hock¹

¹Biomedical Museum, Institute for Medical Research, National Institutes of Health, Ministry of Health Malaysia, Jalan Pahang, 50588 Kuala Lumpur, Malaysia

²Department of Wildlife and National Parks (PERHILITAN) Peninsular Malaysia, KM 10, Jalan Cheras, 56100 Kuala Lumpur, Malaysia

*Corresponding author: Cheong Yoon Ling, Biomedical Museum, Institute for Medical Research, National Institutes of Health, Ministry of Health Malaysia, Jalan Pahang, 50588 Kuala Lumpur, Malaysia, cheongyl@moh.gov.my.

ABSTRACT

Selangor pygmy flying squirrel, *Petaurillus kinlochii*, was classified as “Data Deficient” in the International Union for Conservation of Nature Red List 2016. Scarce information of this species has driven the study on five dry study skin specimens in the Biomedical Museum, IMR and aimed at detailing more information on the morphology of the specimens. These specimens were featured prominently for their distinguished feature of flattened, feather-like white-tipped tails. It is also targeted at updating their procuring records and remeasuring the length of head to body (HB), tails (T), ears (E) and hind foot (HF). The five specimens consisted of HB (80-96 mm), T (61-94 mm), HF (17-20 mm) and E (10-16 mm); and were only discovered in Selangor. Scientists or interest groups are encouraged to access the species collections for further research explorations and collaborations.

KEYWORDS: *Petaurillus kinlochii*, *Sciuridae*, Selangor pygmy flying squirrel, morphological study

INTRODUCTION

Petaurillus kinlochii, a flying squirrel from the Sciuridae family, was the second smallest in the world after *Petaurillus emiliae* of Borneo (Thorington Jr and Ferrell 2007). Locally known as “*Tupai terbang terkecil*”, this species has feather-like, white-tipped tails (Thorington Jr and Ferrell 2007), blackish upper parts of reddish buff, with dull orange tips to the hairs (Jackson 2012). The weight of its skull was approximately 19 grams compared to the giant flying squirrel's skull of 2,000 grams (Thorington Jr and Ferrell 2007). The distribution of *P. kinlochii* thus far was only discovered in the State of Selangor, Malaysia, and is known as “*Selangor pygmy flying squirrel*”. The earliest specimen was collected and described by V. Kinloch at Jeram Estate, Kapar, Selangor on 13th October 1910 (States 1909) and they were subsequently captured by Illar Muul and Lim Boo Liat in 1970 and 1971 respectively. After 30 years from his first visit, during the revisitation at the same site in 2004, the former researcher was unable to identify any trace of *P. kinlochii* as deforestation and other human activities have massively taken place (Thorington Jr and Ferrell 2007).

The Biomedical Museum of Institute for Medical Research (IMR) has conserved five study skin and skull specimens of *P. kinlochii*. These specimens were captured during the ecological and epidemiological survey of mammals of the IMR collaboration projects with the Colonial Scrub Typhus Unit, United Kingdom and the United States Army Medical Research Unit (USAMRU), USA from the year 1947 to 1977 (Izzah et al. 2020). Small mammals were captured for their distributions, nesting behaviours, reproductions, diets, ecto- and endo-parasites (lice, fleas, chiggers and ticks) to investigate the potential hosts for Scrub Typhus disease (Institute for Medical Research 1968).

Petaurillus kinlochii is totally protected by the Wildlife Conservation Act 2010 and was classified as Data Deficient (DD) in the International Union for Conservation of Nature (IUCN) Red List 2016. Conservation and preservation of the species collections are important for the next generation. To the best of our knowledge, the studies on this species are still scarce and based on limited specimens. Although the species has been described, this study is aimed at detailing more information on the morphology of the five specimens kept in IMR.

MATERIALS AND METHODS

The five *P. kinlochii* specimens were identified and cleaned. Photos were captured for their dorsal and ventral view (Figure 1A and 1B). The distinguished morphological feature of the species is their flattened, feather-like white-tipped tails (Figure 1C)(Thorington Jr and Ferrell 2007). Each specimen was examined for proper tagging. The specimens were cross-checked with the log book, catalogue and tags for the length of its head and body (HB), tail (T), ear (E), hind foot (HF), sex, age (adult or young), date of collection, location and collectors. In case of no morphological records, lengths were remeasured according to the Mammals Collector' Manual (Nagorsen and Peterson 1980) using Mitutoyo dial callipers. The locations where *P. kinlochii* were being collected since first discovered was mapped using the QGIS 3.8.1 software (Team QD 2015). The sub-district administrative map was sourced from the Department of Survey and Mapping Malaysia and the land-use map was extracted from OpenStreetMap (OpenStreetMap 2019).

RESULTS

Only one *P. kinlochii* specimen (IMR 99897) was measured in the field and recorded in the logbook, whereas the other four specimens were remeasured in the laboratory. The measurements of the four specimens (IMR 97726, IMR 99898, IMR 102097 and IMR 102098) were recorded as HB (80-96 mm), T (61-94 mm), HF (17-20 mm) and E (10-16 mm) (Table 1). Only one specimen's sex can be determined and it (IMR 97726) was identified as a male adult. The field weight of two specimens was recorded as 25.5 g (IMR 99897) and 16 g (IMR 97726). The location for the specimens were without any recorded coordinates, however one of the specimens (IMR 97726) was found in the district of Tanjung Dua Belas, Selangor (Figure 2).

DISCUSSION

The morphological records of five *P. kinlochii* specimens in IMR served as added knowledge to this data deficient species. The sole type specimen taken in 1910, kept in the Raffles Museum (Table 1) was believed to have been lost (Gibson-Hill 1949). In the web portal of Global Biodiversity Information Facility (GBIF), *P. kinlochii* was found in two occurrence datasets, namely the NHMS Extant Specimen Records of U. S. National Museum



Figure 1. Views of the *P. kinlochii* (IMR 102098) pelage, (A) dorsal, (B) ventral; (C) distinguished by flattened, feather-like white tip tail.

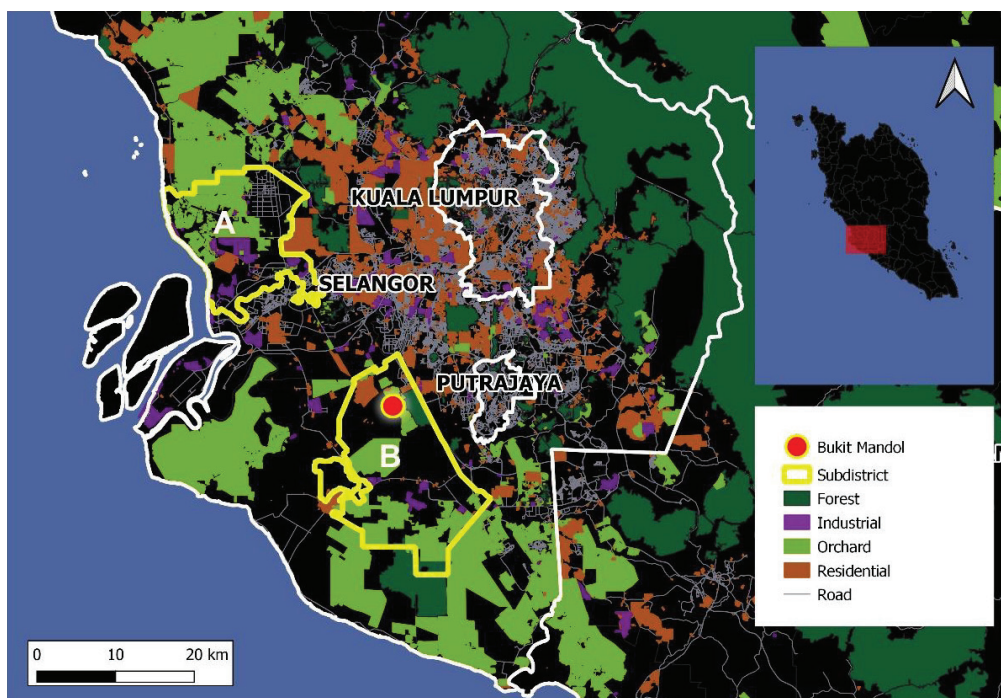


Figure 2. Collecting localities of *Petaurillus kinlochii* in Selangor, Malaysia. Holotype was collected in the (A) sub-district Kapar, district Klang in 1910; Other specimens were collected in Bukit Mandol and (B) sub-district Tanjung Dua Belas, district Kuala Langat in 1970-1972

Smithsonian Institution (USNM) (two males and two females), recorded by Illar Muul and Lim Boo Liat and the mammal's collection of the Museum National d'Histoire Naturelle Paris (MNHN), recorded by Petter Francis with one female specimen (Information GTGB 2020). The first four specimens which were recorded as HB 90 (± 5), Tail 88 (± 7), Tail/HB 0.97 (± 0.03), Mass 24 (± 7), Mass/HB 0.0315 (± 0.0012) (Thorington Jr and Heaney 1981), were longer than IMR's collection in HB and Tail. The Gliding Mammals of the World recorded the details of *P. kinlochii* as HB 80-95 mm, Tail 80-98 mm, HF 19-20 mm and M 17-31g (Jackson 2012), which were similar in HB, but longer in Tail and HF comparing to IMR's collection. There might also be other specimens which are not

recorded online.

The distribution of *P. kinlochii* were endemic in fruit orchards, rubber plantations and moist lowland forests in Malaysia (Jackson 2012; Cadigan Jr and Lim. 1973). One of the IMR's specimen (IMR 97726) was captured in Tanjong Rabok, Kuala Langat, Selangor, Malaysia on 27th July 1972, while the other four were caught between 1972 and 1973 but with unknown locations. The four specimens in USNM were captured in Bukit Mandol, Kuala Langat Forest Reserve, Tanjung Dua Belas, Klang, Selangor on the 25th September 1970, the 20th October 1970, the 29th March 1971 and the 21st May 1971 respectively. The one specimen in MNHN was also discovered in Bukit Mandol, Selangor.

Table 1. Descriptions of the five *P. kinlochii* specimens in IMR and the sole type in Raffles Museum.

Specimen Ref./ Code No.	Date Collected	Collector	Sex	Hb	T	Hf	E	Wt	Location Where Species Was Discovered	Location Of Specimen
99897	1972	NA	NA	86	87	18.5	15	25.5	NA	IMR
97726	27-Jul-1972	Kamal	Sub adult male	80	94	20	16	16	Tanjong Rabok, Kuala Langat, Selangor	IMR
99898	28-Nov-1972	Wa	NA	94	81	19	12	NA	NA	IMR
102097	1973	NA	NA	85	61	20	12	NA	NA	IMR
102098	13-May-1973	Sharif	NA	96	80	17	10	NA	NA	IMR
2668/10	13- Oct-1910	V. Kinloch	Adult female	87	83	19.4	13 (R), 14 (L)		Jeram Estate, Kapar, Selangor	Raffles Museum

HB = head and body length in mm, T = tail length in mm, E = ear length in mm, HF = hind foot length in mm, WT= weight in g, R = right, L = left, NA = Not available.

To date, there is no report on the discovery of *P. kinlochii* outside Selangor, Malaysia.

CONCLUSION

In conclusion, this study not only described the five specimens of *P. kinlochii*, but also confirmed that the Biomedical Museum in IMR is the sole reference study on the skin and skull of *P. kinlochii* in Asia.

The morphological measurements of the specimens were shorter compared to the collections in the other museums. The species was only discovered in moist lowland forest of Selangor, Malaysia and its adaptation capabilities and local habitats are still unknown. Hence, more collaboration projects have to be enhanced among zoologists, biologists and ecologists for further studies and explorations in this field.

ACKNOWLEDGEMENTS

The authors wish to thank the Director General of Health, Malaysia, for permission to publish this paper. We are also grateful to all staff of the Biomedical Museum, IMR who have contributed significantly to the curation of specimens and capturing of photos.

REFERENCES

- Cadigan Jr, FC, and BL Lim. 1973. "Protected Habitats for Protected Animals." *Proc. Symp. Biol. Res. And Nat. Dev.*, 153–57.
- Gibson-Hill, CA. 1949. "Bird and Mammal Type Specimens in the Raffles Museum Collections." *Bull. Raffles. Mus.* 19: 192. <https://lkcnhm.nus.edu.sg/wp-content/uploads/sites/10/app/uploads/2017/06/19brm133-198.pdf>.
- Information GTGB. 2020. "What Is GBIF?" *Www.gbif.org*. May 26, 2020. <https://www.gbif.org/what-is-gbif>.
- Institute for Medical Research. 1968. "Annual Report of the Institute for Medical Research for 1968." Kuala Lumpur: Jabatan Chetak Kerajaan.
- Izzah, ATNS, I Munajat, N Majid, N Osman, SA Samson, MH Sulong, RM Sapran, M Ahamad, and BL Lim. 2020. "A Study on the Collections of the Greater Marmoset Rat, *Hapalomys Longicaudatus* (Rodentia: Muridae) in a Peninsular Malaysia." *Malayan Nature Journal* 72 (1): 1–9.
- Jackson, SM. 2012. *Gliding Mammals of the World*. Collingwood, Vic.: Csiro Pub.
- Nagorsen, DW, and RL Peterson. 1980. *Mammal Collector's Manual: A Guide for Collecting, Documenting and Preparing Mammal Specimens*. Brill.com. Leiden, The Netherlands: Brill. <https://brill.com/view/title/4124>.
- OpenStreetMap. 2019. "Planet Dump." OpenStreetMap. Openstreetmap Foundation. 2019. <https://www.openstreetmap.org>.
- States, FM. 1909. "Journal of the Federated Malay States Museums." *Journal of the Federated Malay States Museums* 4 (December): 171–72. https://www.forgottenbooks.com/en/books/JournaloftheFederatedMalayStatesMuseums_10631996.
- Team QD. 2015. "Open Source Geospatial Foundation Project." QGIS Geographic Information System. 2015. <http://qgis.osgeo.org>. 2015.
- Thorington Jr, RW, and K. E. Ferrell. 2007. "Squirrels:

The Animal Answer Guide." *Journal of Mammalogy* 88 (3): 824–24. <https://doi.org/10.1644/06-mamm-r-397r.1>.

Thorington Jr, RW, and LR Heaney. 1981. "Body Proportions and Gliding Adaptations of Flying Squirrels (Petauristinae)." *Journal of Mammalogy* 62 (1): 101–14. <https://doi.org/10.2307/1380481>.