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# THE TERRESTRIAL MAMMALS OF PULAU TIOMAN, PENINSULAR MALAYSIA, WITH A CATALOGUE OF SPECIMENS AT THE RAFFLES MUSEUM, NATIONAL UNIVERSITY OF SINGAPORE

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***ABSTRACT.*** - 45 species of land mammals have been recorded from Pulau Tioman. Apart from feral cattle and unconfirmed records of *Macaca nemestrina*, *Arctogalidia trivirgata* and *Arctictis binturong*, 41 species are of confirmed occurrence. 17 subspecies of mammals have been described from Tioman and are endemic to the island. Species which have remained common in the last ten decades include *Pteropus hypomelanus*, *Cynopterus brachyotis*, *Callosciurus notatus*, *Tupaia glis*, *Rattus tiomanicus* and *Tragulus napu*. However, the Tioman forms of *Nycticebus coucang* and *Rhinosciurus laticaudatus* have not been reported since 1927 and could have become extinct. A catalogue of 319 specimens of 22 species of land mammals from Pulau Tioman housed at the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore, is presented.

***KEY WORDS.*** - checklist, land mammals, Pulau Tioman.

## INTRODUCTION

The present report of the mammalian fauna of Pulau Tioman, a hilly island located in the South China Sea off the east coast of Peninsular Malaysia, is an update of various collections and observations made between 1899 and 1927 to the most recent ones in 1997. It comprises both published and unpublished information from different surveys covering mainly three different time periods as follows (see also Appendix 1).

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1899-1927 - scattered historical accounts of specimens collected by C. Boden Kloss, E. Seimund, H. C. Robinson, N. Smedley, W. L. Abbott, and collectors from the Raffles Museum (see Miller, 1900, 1903; Kloss, 1908; Thomas, 1908; Elliot, 1909; Robinson, 1912, 1917; Kloss, 1917; Andersen, 1918; Chasen, 1940; Hill, 1960). Specimens were deposited in museums in the United States and the Natural History Museum in London, but a large proportion of these were retained at the Raffles Museum, now part of the Zoological Reference Collection of the Raffles Museum of Biodiversity Research at the National University of Singapore (see catalogue in Appendix 2).

1962 - systematic collections from March to April 1962 reported in Medway (1966). The specimens are deposited at the Insititute of Medical Research (IMR) and the Department of Zoology at Universiti Malaya in Kuala Lumpur, Malaysia. In addition, there is also a report on new records of bats by Hill (1974).

1987-present - surveys were conducted by the Malaysian Department of Wildlife and National Parks (DWNP) from 28 April to 2 May 1995 (see DWNP, 1995), and by Csorba et al. (1997) from 13 to 16 March 1995. Also included are scattered reports from various individuals dating back to 1987 (e.g., Zubaid, 1988; Diong, 1993), and observations by the second author (KKPL) and his colleagues in 1996 and 1997.

To date, a total of 45 species of land mammals has been recorded from Pulau Tioman. Of these 41 species are of confirmed occurrence, one is of feral origin, and three are unconfirmed records. The records of *Macaca nemestrina, Arctogalidia trivirgata* and *Arctictis binturong* should be treated as unconfirmed until evidence becomes available to prove their natural occurence on the island. Seventeen subspecies of mammals have been described from Tioman and are endemic to the island and Pulau Tulai. Diagnostic characters of the endemic subspecies are provided in Medway (1966).

Although not mentioned in the last comprehensive treatment of Tioman mammals (Medway, 1966), there is a collection of mammal specimens from that island obtained between 1899 and 1927 in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research at the National University of Singapore. These materials were collected by C. B. Kloss, E. Seimund, H. C. Robinson, N. Smedley, W. L. Abbott, and other collectors from the Raffles Museum. Part of H. C. Robinson's collection which includes specimens from Tioman is now at the Natural History Museum in London (Hill, 1960). The entire catalogue of the ZRC holdings of Tioman mammals is presented in Appendix 2.

## ANNOTATED CHECKLIST

This list is compiled largely from Medway (1966, 1983), Hill (1974), surveys of the DWNP team (1995) and Csorba et al. (1997). Classification and nomenclature follow Corbet & Hill (1992). The taxa are grouped in their respective orders and families, and each taxon discussed accordingly. The mammalian fauna of Pulau Tulai, a small island off the northern tip of Tioman is mentioned, but not dealt with in detail in this paper. Sungai (Sg.) is the Malay vernacular term for river stream, Kampung (Kg.) for village, and Tanjung (Tg.) for headland.

## ORDER INSECTIVORA

### FAMILY ERINACEIDAE

***Hylomys suillus tionis* Chasen** Lesser Gymnure

Reported by Medway (1966: 10), this animal was not observed by Csorba et al. (1997) and DWNP (1995). There is a recent sighting of an individual on Gunung Kajang in June 1996 by Alvin Wong (pers. comm. to KKPL). This species is fairly common in undisturbed primary forests at all elevations on mainland Peninsular Malaysia (Medway, 1983).

### FAMILY SORICIDAE

***Crocidura negligens tionis* Kloss** Tioman White-toothed Shrew

Originally described as *Crocidura tionis* by Kloss (1917), it was later regarded as a subspecies of *C. malayana* (Medway, 1966: 11) and subsequently referred to as *C. fuliginosa* (Corbet & Hill, 1992). It is recently found to be conspecific with *C. negligens*, a species described by Robinson & Kloss (1914) from Koh Samui off Southern Thailand (Ruedi, 1996; Ruedi et al., 1990). On Tioman, it has recently been collected by Csorba *et al.* (1997), but not by the DWNP (1995) team. It occurs in forest, but has been known to enter houses on Tioman (Medway, 1966: 11).

## ORDER DERMOPTERA

### FAMILY CYNOCEPHALIDAE

***Cynocephalus variegatus taylori* (Thomas)** Malayan Colugo

Recently, individuals were sighted by DWNP (1995) and Csorba et al. (1997). Tan (1972) managed to collect five individuals from coconut plantations at Tekek in October 1971. Medway (1966: 12) stated that the colugo was observed from primary forest to coconut plantation in various parts of Tioman, a habitat likewise reported for mainland Peninsular Malaysia (Lim, 1967; Medway, 1983). *Cynocephalus variegatus taylori* is endemic to Pulau Tioman.

## ORDER CHIROPTERA

### FAMILY PTEROPODIDAE

***Cynopterus brachyotis brachyotis* (Müller)** Lesser Dog-faced Fruit Bat

Medway (1966: 12, 23) collected 12 (5m, 7f) from Tioman and Pulau Tulai, and asserted that they were on average larger than those found on the mainland. DWNP (1995) netted three individuals (1m, 2f) in Kg. Asah. One of the females was pregnant with a fully developed embryo. Body measurements in mm and weight in grams - head & body 84, 88, 89; tail 14, 14.5, 15; forearm 67.5, 61.5, 68.5; tibia 26, 27.5, 27.5; ear 18, 19, 20; weight 37, 41.6, 43.4.

***Cynopterus horsfieldi* Gray** Horsfield's Fruit Bat

Eight examples (3m, 5f) were netted in forest and around plantations by DWNP (1995) survey team. Two of the females were pregnant with a single fully developed embryo each. Body measurements in mm and weight in grams - head & body 87-103 (mean 94.7), tail 12-16 (mean 13.6), forearm 70.4-76.1 (mean 73.1), tibia 26.5-29 (mean 27.9), ear 19-22 (mean 19.5), weight 43.1-59.8 (mean 52.1). This is the first record of *Cynopterus horsfieldi* from Tioman. It differs from *C. brachyotis* by its larger size and presence of a small accessory cusp in the centre of the biting surfaces of the third and fourth lower cheek teeth.

***Eonycteris spelaea* (Dobson)** Cave Fruit Bat

Medway (1966: 13) collected several specimens, including two pregnant females, in scrub and plantation in Tekek and Mukut. Three (2m, 1f) were netted in forest at Kg. Asah by DWNP (1995). A suckling juvenile female was found with the single female netted. Body measurements in mm and weight in grams (of three specimens) - head & body 105, 110, 87; tail 17, 17, 16; forearm 63, 57.3; tibia 30, 29,25.5; ear 17, 17, 19; weight 42.6, 41.4, 32.8. Csorba et al. (1997) also netted this species, but they did not provide details.

A male specimen of the nectar-feeding Common Long-tongued Fruit Bat, *Macroglossus minimus minimus* (Geoffroy), was collected from neighbouring Pulau Tulai (Medway, 1966: 23 as *Macroglossus lagochilus* cf. *lagochilus*), but not from Tioman. As it is a coastal species which frequents areas of mangrove and beach vegetation, it can be expected from Pulau Tioman as well.

***Pteropus hypomelanus lepidus* Miller** Island Flying Fox

This large fruit bat is still common on Tioman (Medway, 1966: 12; DWNP, 1995; Csorba *et al.*, 1997). Three roosting sites in coconut palms on the foreshore, one at Tg. Batang Air and two at Tg. Mentawak, were identified. About 300 individuals were estimated to be present in each of these roosts. In addition, KKPL was shown a roosting colony at the northern end of Tekek beach in June 1997.

FAMILY EMBALLONURIDAE

***Emballonura monticola monticola* Temminck** Lesser Sheath-tailed Bat

Apart from a pregnant female shot over Tekek in March 1962 (Medway, 1966: 13), there has been no recent reports of this species from Tioman.

FAMILY NYCTERIDAE

***Nycteris javanica tragata* Andersen** Hollow-faced Bat

A male was netted at Kg. Asah by the DWNP (1995) team. Body measurements in mm and weight in grams - head & body 65, tail 75, forearm 51.3, tibia 30, ear 30, weight 16.5. This is a new record for Pulau Tioman.

FAMILY MEGADERMATIDAE

***Megaderma spasma* (Linnaeus)** Malayan False Vampire

Csorba *et al.* (1997) collected this species in March 1995 in the vicinity of Kg. Juara. They found a roost within a deserted house, and another between boulders 2 km south of the village. Between 23 and 24 June 1997, seven individuals were identified and photographed under the thatch-covered zinc roof of an unused hut along Sg. Asah (KKPL pers. obs.).

FAMILY RHINOLOPHIDAE

***Rhinolophus affinis superans* Andersen** Intermediate Horseshoe Bat

A male and a female were netted in the forest at Mukut by Medway (1966: 13). DWNP (1995) obtained two males at Kg. Asah. Body measurements in mm and weight in grams (of the two males) - head & body 58, 56; tail 24, 25; forearm 49, 50.5; tibia 23, 24; ear 20, 20; weight 10.2, 10.7. Csorba et al. (1997) also collected this species.

***Rhinolophus borneensis* Peters** Bornean Horseshoe Bat

This species was first recorded for Tioman by Csorba et al. (1997) from the secondary forest at Juara.

***Rhinolophus lepidus refulgens* Andersen** Glossy Horseshoe Bat

Medway (1966: 13) recorded this species as *Rhinolophus refulgens refulgens*. Corbet & Hill (1992) assigned it to *R. lepidus*. A female netted by DWNP (1995) at Kg. Asah has the following measurements (in mm & grams): head & body 41, tail 21, forearm 41.5, tibia 17, ear 16, weight 6.0. This species was also obtained by Csorba et al. (1997).

***Rhinolophus luctus morio* Gray** Woolly Horseshoe Bat

A male netted in the forest at Kg. Asah by the DWNP (1995) team constitutes a new record for Pulau Tioman. Measurements (in mm & grams): head & body 75, tail 40, forearm 65.6, tibia 32.2, ear 30, weight 24.7.

***Rhinolophus macrotis* Blyth** Big-eared Horseshoe Bat

This bat was first recorded from Tioman by Csorba et al. (1997).

***Rhinolophus megaphyllus klossi* Andersen** Peninsular Horseshoe Bat

This horseshoe bat, collected by H. C. Robinson and said to occur on both Tioman and Pemanggil islands, was later found to be from Pemanggil (Hill, 1960). Medway (1966: 13 as *Rhinolophus klossi*) said that its inclusion among Tioman's fauna may be in error. Although not reflected in any publication, there is a specimen identified as *Rhinolophus klossi* at the ZRC collected at Juara Bay in September, 1907 (see Appendix 2). *R. klossi* was regarded as a subspecies of *R. robinsoni* by Medway (1983: 24).

***Rhinolophus pusillus pusillus* Temminck** Least Horseshoe Bat

Hill (1974) first recorded this species from Tioman. Subsequently, the DWNP (1995) team netted a female at Kg. Asah whose body measurements (in mm & grams) are as follows: head & body 41, tail 15, forearm 40, tibia 15, ear 13, weight 5.9.

***Rhinolophus stheno* Andersen** Lesser Brown Horseshoe Bat

First recorded from Tioman by Csorba et al. (1997) who collected this species in secondary forest at Juara. On the mainland, this bat is apparently common in both secondary and primary forests (Medway, 1983).

FAMILY HIPPOSIDERIDAE

***Aselliscus stoliczkanus* Dobson** Stoliczka's Trident Bat

This bat was previously known in Peninsular Malaysia from the type specimen collected in Penang in 1871 (Medway, 1983). It was not reported again in Peninsular Malaysia until the recovery of a male specimen from Tioman in April 1987 by Zubaid (1988) after 116 years.

***Hipposideros bicolor atrox* Andersen** Bicolored Leaf-nosed Bat

Medway (1966: 14) netted this bat in disturbed forest at Mukut. It was subsequently collected in Juara by Csorba et al. (1997), but not recorded by the DWNP (1995) team.

***Hipposideros larvatus barbensis* Miller** Large Leaf-nosed Bat

This species was recorded by Hill (1960) from Tioman and Pulau Aur, but Medway (1966: 14) failed to obtain any specimens. A male netted at Kg. Asah by the DWNP (1995) team has the following body measurements (in mm & grams): head & body 62, tail 37, forearm 60, tibia 24, ear 20, weight 15.5. This bat was also collected by Csorba et al. (1997).

FAMILY MOLOSSIDAE

***Cheiromeles torquatus torquatus* Horsfield** Hairless Bat

There are five specimens collected from Tioman in the ZRC (Appendix 2). This conspicuous bat, observed in flight by Medway (1966: 14) was not reported by the DWNP (1995) team or Csorba et al. (1997).

ORDER SCANDENTIA

FAMILY TUPAIIDAE

***Tupaia glis sordida* Miller** Common Treeshrew

This common subspecies is a Tioman endemic. Medway (1966: 14) reported that it formed 21.1% (53) of 251 catches of all species trapped, while it constituted 55.2% (16) of 29 of all species trapped by the DWNP (1995) team. All of the 16 individuals (9m, 7f) obtained by the latter were adults, and four of the females were pregnant. One of the pregnant females

had three foetuses, and another had two advanced foetuses. They were trapped at Kg. Asah, Tg. Mentawak and Tg. Chekau. Csorba et al. (1997) observed this animal at Juara.

## ORDER PRIMATES

### FAMILY LORISIDAE

***Nycticebus coucang insularis* Robinson** Slow Loris

This subspecies, unique to Tioman, remains a historical record (Robinson, 1917). Medway (1966: 16) reported a specimen supposedly caught by villagers in Mukut in 1958, but failed to see or collect any during his survey in 1962. There have been no recent reports, and it is possible that this animal does not exist on the island any more.

### FAMILY CERCOPITHECIDAE

***Macaca fascicularis laeta* (Elliot)** Long-tailed Macaque

The subspecies is found on both Tioman and Pemanggil islands. It was recorded as common on Tioman by Medway (1966: 16). In recent surveys, troops of two to six members were commonly observed at Tg. Mentawak, Air Hantu, Kg. Juara, Sg. Keliling, Sg. Paya, Tg. Salang, Tg. Temedor, Tg. Dungun, Tg. Benuang, Ulu Sg. Benuang and Kg. Air Batang by DWNP (1995). Sightings at Kg. Juara were also obtained by Csorba et al. (1997). KKPL noted troops of this monkey in mangrove trees along Monkey Bay on 25 June 1997, and behind Kg. Mukut on 26 June 1997. Although inhabiting forests and mangroves, the Long-tailed Macaque can be a pest in plantations.

A captive individual of *Macaca nemestrina* (Linnaeus), the Pig-tailed Macaque, was recently observed by DWNP (1995) at Kg. Juara. As there was never any past record of this species on Pulau Tioman, this example is almost certainly brought over from the mainland. In Malaysia, the Pig-tailed Macaque is often domesticated to assist in harvesting coconuts.

## ORDER RODENTIA

### FAMILY SCIURIDAE

***Callosciurus nigrovittatus microrhynchus* (Kloss)** Black-banded Squirrel

The subspecies is unique to Tioman. Three individuals (2m, 1f) were trapped in lowland forest by DWNP (1995). Csorba et al. (1997) also saw this squirrel at Kg. Juara. Medway (1996: 17) collected six specimens in forest below 500 feet, none above that altitude. KKPL observed three to four individuals along Sg. Asah on 24 June 1997. It seems that on Tioman, this squirrel is restricted to lowland forests, and is common, but not as abundant as *Callosciurus notatus*.

***Callosciurus notatus tenuirostris* (Miller)** Plantain Squirrel

There are 39 specimens at the ZRC collected from Tioman between 1906 and 1927 (Appendix 2). Medway (1966: 16, 24) observed this squirrel to be abundant in forest at all elevations, but particularly in plantations and settlements where they can be a serious pest. Eleven

individuals (6m, 5f) were trapped at Tg. Mentawak, Kg. Air Batang, Permatang Bukit and Ulu Sg. Keliling by DWNP (1995). Sightings were also made at Juara by Csorba et al. (1997). KKPL sighted at least two examples on casuarina trees along Tekek beach in June 1997. *Callosciurus notatus tenuirostris* is endemic to Tioman and Tulai islands and appears to be the only squirrel found on Pulau Tulai.

***Lariscus insignis fornicatus* Robinson** Three-striped Ground Squirrel

There are four examples of this subspecies at the ZRC collected between 1915 and 1927 (Appendix 2). Ten individuals of this terrestrial squirrel were trapped in forest at all elevations by Medway (1966: 18) but none was obtained recently (DWNP, 1995; Csorba et al., 1997). On the mainland, *Lariscus insignis* is restricted to lowland forests. At the Pasoh forest reserve in Negeri Sembilan, it is still found in abundance (BLL, pers. obs.). *Lariscus insignis fornicatus* is a subspecies unique to Tioman.

***Ratufa bicolor tiomanensis* Miller** Black Giant Squirrel

Medway (1966: 16) reported this large arboreal squirrel to be common in forest at all elevations on Tioman. The DWNP (1995) team sighted six examples at Tg. Mentawak, Sg. Paya, Tg. Peradong, Kg. Air Batang and Ulu Sg. Benuang, and suggested that it was common as its loud alarm calls were frequently heard in the forest. Csorba et al. (1997) observed this animal in Juara. KKPL identified one animal in the forest canopy behind Kg. Salang on 25 June 1997. The subspecies is endemic to Tioman.

***Rhinosciurus laticaudatus robinsoni* Thomas** Shrew-faced Ground Squirrel

This subspecies is endemic to Tioman, and there are 14 examples at the ZRC collected between 1906 and 1927 (Appendix 2) which indicate that this squirrel was once common on the island. The absence of records since 1927 supports the suggestion of Medway (1966: 19) that the subspecies may be extinct. On mainland Peninsular Malaysia, the Shrew-faced Ground Squirrel is restricted to primary forest (Medway, 1983), but is apparently not as common as the sympatric *Lariscus insignis* (BLL, pers. obs.).

***Sundasciurus tenuis tiomanicus* (Robinson)** Slender Squirrel

There are 22 specimens at the ZRC collected between 1907 and 1927 (Appendix 2). Medway (1966: 17) observed this arboreal squirrel to be common in tall forest throughout Tioman where seven individuals were trapped. In recent surveys, none were obtained nor observed (DWNP, 1995; Csorba et al., 1997). On the mainland, this species is not habitat specific, ranging from primary and secondary forests at all elevations to plantations (oil palm, rubber, coconut) and orchards where it may become a pest (BLL, pers. obs.). *Sundasciurus tenuis tiomanicus* is endemic to Tioman.

FAMILY PTEROMYIDAE

***Iomys horsfieldii* cf. *davisoni* (Thomas)** Horsfield's Flying Squirrel

Two individuals were collected in durian plantations at Setegap by Medway (1966: 19). The animal was also sighted at Juara in March 1995 by Csorba et al. (1997). DWNP did not report having observed any, but their visit probably did not co-incide with the flowering or fruiting season on the island. On the mainland, this squirrel is not habitat-specific, and

can be a pest in orchard plantations (BLL, pers. obs.).

***Petaurista petaurista melanotus* (Gray)** Red Giant Flying Squirrel

Two individuals of this nocturnal animal were collected by Medway (1966: 19) during the fruiting season at Setegap and Juara. Csorba et al. (1997) sighted an animal at Juara in March 1995, but none was reported by DWNP (1995). According to the team personnel of DWNP, the local villagers on Tioman asserted that this squirrel was common during the flowering season in durian plantations. On 15 September 1992, two examples of this squirrel were observed and photographed by Diong (1993) along the Tekek-Juara trail near Kg. Juara at 1730 hrs.

FAMILY MURIDAE

***Leopoldamys sabanus stridens* (Miller)** Long-tailed Giant Rat

The subspecies is endemic to Tioman where it was common, and 33 individuals were obtained by Medway (1966: 20 as *Rattus sabanus stridens*) in forest at all elevations, and also from rice stubble at Kg. Tekek. In the survey by DWNP (1995), only three examples were trapped at Kg. Asah. However, this may be due to time factor of trapping, and may not reflect the present adundance of this rat on the island.

***Maxomys surifer binominatus* (Kloss)** Red Spiny Rat
(Fig. 1.)

The subspecies endemic to Tioman was abundant in forest or bush. There are 41 specimens in the ZRC collected between 1907 and 1916 (Appendix 2). Medway (1966: 21 as *Rattus surifer binominatus*) and the IMR collected 38 examples. Recent surveys (DWNP, 1995; Csorba et al., 1997) did not report this species, but this could have been due to the traps having been set at inappropriate times or places. However, in June 1996, Benjamin Lee (pers. comm. to KKPL) observed this rat to be common on Gunung Kajang where individuals emerged in the night to raid rucksacks for food. One was even photographed in the process (Fig. 1).

Fig. 1. *Maxomys surifer binominatus* on Gunung Kajang, June 1996 (photographed by Benjamin Lee).

***Niviventer cremoriventer cremoriventer* (Miller)** Dark-tailed Tree Rat

First recorded from Tioman by Medway (1966: 22 as *Rattus cremoriventer* subsp.??) where four individuals including one obtained by the IMR were trapped in habitats ranging from scrub and bamboo forests to lowland and hill forests. In the recent surveys by Csorba et al. (1997) and DWNP (1995), however, none was reported. On mainland Peninsular Malaysia, this arboreal rat is more frequently caught in traps placed off the ground on tree stumps than on the forest floor (BLL, unpublished data). The scarcity of Tioman records could be due to traps being placed mostly on the forest floor.

***Rattus exulans concolor* (Blyth)** Polynesian Rat

The smallest member of the genus *Rattus*, it was trapped only around areas inhabited by humans on Tioman, and was abundant to the degree of being a pest within its environment (Medway, 1966: 20). The absence of records in recent surveys (DWNP, 1995; Csorba et al., 1997) was probably because trapping was not carried out around human habitations. On mainland Peninsular Malaysia, this rat frequents scrubs, cultivated areas and surrounding human habitations (Harrison, 1966).

***Rattus tiomanicus tiomanicus* (Miller)** Malaysian Wood Rat

The taxonomic position of this rat was revised by Medway & Lim (1966). This nominate subspecies is endemic to Tioman and Pulau Tulai, and was the commonest mammal species collected there at all elevations (Medway, 1966: 20 as *Rattus* sp. *tiomanicus*). Recently, DWNP collected only 5 (2m, 3f) individuals at Kg. Asah compared to the 91 reported by Medway (1966) which included the IMR collection. The low number obtained by DWNP does not necessarily reflect the abundance of this rat on the island. On mainland Peninsular Malaysia, *Rattus tiomanicus* frequents highly-disturbed forests and cultivated areas, and is the main pest in oil palm plantations (Medway, 1983). It is also a serious pest in plantations on Tioman.

## FAMILY HYSTRICIDAE

***Atherurus macrourus tionis* Thomas** Brush-tailed Porcupine

Two examples were collected by Medway (1966: 22) while DWNP (1995) obtained one at Kg. Asah. Csorba et al. (1997) sighted this animal at Juara in March 1995. The frequent sightings at night of this porcupine in the forest by Medway and also by BLL during Tioman surveys in 1962 revealed that it was very common then. This rodent is a pest in plantations, but according to the local villagers, it is periodically caught for food. This subspecies is endemic to Tioman.

# ORDER CARNIVORA

## FAMILY VIVERRIDAE

***Paradoxurus hermaphroditus milleri* Kloss** Common Palm Civet

On Tioman, two individuals were observed by Medway (1966: 23), and one was trapped at Kg. Asah by DWNP (1995). On the mainland, the Common Palm Civet is apparently the

most common and adaptable member of the Viverridae, being frequently found in human habitations and plantations. Although only three animals were recently recorded on the island, it is likely that this endemic subspecies will thrive.

The Small-toothed Palm Civet, *Arctogalidia trivirgata* (Gray) was tentatively included by Medway (1966: 23). Villagers at Kg. Mukut had said that two species of civets inhabit Tioman, and their descriptions of the second suggested this species.

The Binturong or Bear-cat, *Arctictis binturong* (Raffles), was reported by villagers as being present in the forest at Tg. Salang (DWNP, 1995). The uniformly black shaggy coat and long prehensile tail make this a very distinct and easily-recognised animal. Unless one is captured or photographed, its presence on the island must remain unconfirmed.

## ORDER ARTIODACTYLA

### FAMILY TRAGULIDAE

***Tragulus napu rufulus* Miller** Large Mouse Deer

Medway (1966) collected one and observed many individuals on Tioman. DWNP (1995) observed 36 in the forest at Tg. Mentawak, Air Hantu, Kg. Juara, Sg. Paya, Ulu Benuang, Ulu Sg. Asah and Sg. Temodor. Their observations confirmed that the mousedeer was still common on the island. In June 1997, two mousedeer were observed in the forest behind Kg. Paya (N. Sivasothi, pers. comm. to KKPL). Kloss (1918, as *Tragulus javanicus rufulus*) notes that the Tioman animals are the most brilliantly coloured of all mousedeer. Yong (1973) conducted a chromosonal study on a juvenile female and concluded that the Tioman mouse deer is indeed *Tragulus napu*.

Feral domestic cattle were observed in the forest inland of Teluk Dungun on the east coast of Tioman (Medway, 1966 as *Bos* sp.). The Institute of Medical Research (IMR) team, whose survey of the island was at the same period as Medway's, also recorded similar observations. It is possible that remnant populations of these feral cattle still exist at Teluk Dungun, although the site was not visited by the team from DWNP (1995).

## DISCUSSION

The total time span covering the three periods of major mammal collections on Pulau Tioman is 106 years. 73 years elapsed between the early zoological expeditions that dated as far back as 1899 (see Chasen, 1940) and the 1962 collection by Medway (1966), and 33 years between Medway's survey and the recent ones carried out in 1995 by Csorba et al. (1997) and DWNP (1995), and subsequent incidental observations.

Among these collections and observations, 27 (historical records), 30 (Medway, 1966), 34 (DWNP, 1995; Csorba et al., 1997; present observations) species of land mammals were recorded respectively. There appears to be differences in the species composition during the three periods of mammal surveys. Four species (two bats, *Nycticebus* and *Rhinosciurus*) reported in the early collections were not reported as present in 1962 by Medway (1966). However, Medway's team collected an additional five species (three bats, a flying squirrel

and a rat) as new records for Tioman. In the collection made by DWNP (1995), 12 species (*Hylomys*, *Crocidura*, three bats, four squirrels and three rats) were not represented. However, they added six new records (four bats, the Pig-tailed Macaque and the Binturong) for the island. The latter two species should be considered unconfirmed until further evidence proves their natural existence. Csorba et al. (1997) added four bat records for Tioman during their survey in 1995, but they did not report nine mammal species obtained by the DWNP team on their survey in the same year.

The roundleaf bat, *Hipposideros larvatus barbensis*, reported by Hill (1960) was not collected in 1962 (Medway, 1966). This species was recovered by DWNP (1995) and Csorba et al. (1997) after a lapse of 106 years. On the other hand, *Rhinolophus megaphyllus klossi, Nycticebus coucang insularis* and *Rhinosciurus laticaudatus robinsoni*, reported by past workers, were not found again by Medway (1966), DWNP (1995) or Csorba et al. (1997). The lack of *N. coucang* and *R. laticaudatus* records after 106 years suggests that they may be extinct on Tioman.

The recovery of *Hipposideros larvatus* by DWNP (1995) and Csorba et al. (1997) after more than ten decades seems to indicate low sampling intensity or efficiency in the intervening years. Since 1987, there have been no records of *Hipposideros atrox, Cheiromeles torquatus, Sundasciurus tenuis, Lariscus insignis, Rattus exulans* and *Niviventer cremoriventer* from Tioman. This could be due to environmental changes in habitats, and/or low trapping intensity.

Between the late 1800s and Medway's (1966) surveys in 1962, Tioman island was not disturbed by extensive development. In the early 1980s, a large resort hotel was built slightly inland along the coastal area on the west to promote tourism. In subsequent years, resort accomodation facilities have been expanded. These developments have increased the inflow of visitors to the island. Although these developments are situated outside the forest, the visitors inevitably intrude into the forest for recreation and, in the process, disturb the ecosystem. The two species of squirrels, *Sundasciurus* and *Lariscus*, are greatly influenced by food resources, but they are able to withstand disturbances as long as the forest is still intact. Of the rats, *Rattus exulans* is commensal with humans and is unlikely to be affected, while *Maxomys* and *Niviventer* are forest dwellers which can survive slight deterioration of their natural habitats. The latter two species are common in disturbed primary and secondary forests on the mainland.

The relatively low trapping intensity is more likely to be the main reason why certain species were not obtained since 1995. Only five days of trapping with 200 trap-nights were carried out by the DWNP (1995) team, and four days of netting and observations by Csorba et al. (1997). In contrast, Medway (1966) carried out 30 days of trapping with 708 trap-nights in 1962. The failure to obtain *Rattus exulans* in the 1995 surveys could be due to the work having been conducted in forested areas.

Generally, island ecosystems harbour a relatively limited mammalian species diversity compared to forests on the mainland, and Tioman is no exception. For example, Lim *et al.* (1977) recorded 84 species (including 40 species of bats) from the Bukit Lanjan Forest Reserve in Selangor. Tioman presently has 41 species (including 19 species of bats). It is also interesting to note that there is not a single record of a vespertilionid bat on Tioman, the microchiropteran fauna consisting largely of the horseshoe and leaf-nosed bats of the families Rhinolophidae and Hipposideridae. The Vespertilionidae are by far the most speciose family of bats in Peninsular Malaysia with at least 37 species (Medway, 1983; Francis, 1997;

Kingston et al., 1997). We are unable to explain their absence on Tioman, but it is possible that they may have been overlooked.

Seventeen subspecies of mammals described from Tioman are endemic to that island. It is pertinent to note that these taxa can be susceptible to drastic alterations and disturbances on their natural environment. Recent studies have suggested that the Tioman forms of *Nycticebus coucang* and *Rhinosciurus laticaudatus* could have become extinct. Taxa which have remained common in the last ten decades on Tioman include *Pteropus hypomelanus, Cynopterus brachyotis, Callosciurus notatus, Tupaia glis, Rattus tiomanicus* and *Tragulus napu*.

Even after three periods of data collection, the study of mammalian diversity on Pulau Tioman is by no means complete. It is not unreasonable to assume that with greater effort and more intensive trapping, new records of bats and perhaps other mammal species will be found, and those species not recorded again since the historical collections will be rediscovered.

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APPENDIX 1: Checklist of the land mammals of Pulau Tioman.

| S/No. | Taxon | Time period of main surveys | | |
|---|---|---|---|---|
| | | 1987 - present | 1962 | 1899-1927 |
| 1. | ***Hylomys suillus tionis*** | + | + | + |
| 2. | ***Crocidura negligens tionis*** | + | + | + |
| 3. | ***Cynocephalus variegatus taylori*** | + | + | + |
| 4. | *Pteropus hypomelanus lepidus* | + | + | + |
| 5. | *Cynopterus brachyotis brachyotis* | + | + | - |
| 6. | *Cynopterus horsfieldi* | + | - | - |
| 7. | *Eonycteris spelaea* | + | + | - |
| 8. | *Emballonura monticola monticola* | - | + | + |
| 9. | *Nycteris javanica tragata* | + | - | - |
| 10. | *Megaderma spasma* | + | - | - |
| 11. | *Rhinolophus affinis superans* | + | + | + |
| 12. | *Rhinolophus borneensis* | + | - | - |
| 13. | *Rhinolophus macrotis* | + | - | - |
| 14. | *Rhinolophus megaphyllus klossi* | - | - | + |
| 15. | *Rhinolophus lepidus refulgens* | + | + | + |
| 16. | *Rhinolophus luctus morio* | + | - | - |
| 17. | *Rhinolophus pusillus pusillus* | + | - | - |
| 18. | *Rhinolophus stheno* | + | - | - |
| 19. | *Aselliscus stoliczkanus* | + | - | - |
| 20. | *Hipposideros bicolor atrox* | + | + | - |
| 21. | *Hipposideros larvatus barbensis* | + | - | + |
| 22. | *Cheiromeles torquatus torquatus* | - | + | + |
| 23. | ***Tupaia glis sordida*** | + | + | + |
| 24. | ***Nycticebus coucang insularis*** | - | - | + |
| 25. | *Macaca fascicularis laeta* | + | + | + |
| 26. | *Macaca nemestrina nemestrina* | ? | - | - |
| 27. | ***Ratufa bicolor tiomanensis*** | + | + | + |
| 28. | ***Callosciurus notatus tenuirostris*** | + | + | + |
| 29. | ***Callosciurus nigrovittatus microrhynchus*** | + | + | + |
| 30. | ***Sundasciurus tenuis tiomanicus*** | + | + | + |
| 31. | ***Lariscus insignis fornicatus*** | - | + | + |
| 32. | ***Rhinosciurus laticaudatus robinsoni*** | - | - | + |
| 33. | *Iomys horsfieldii* cf. *davisoni* | + | + | - |
| 34. | *Petaurista petaurista melanotus* | + | + | + |
| 35. | ***Rattus tiomanicus tiomanicus*** | + | + | + |
| 36. | ***Maxomys surifer binominatus*** | + | + | + |
| 37. | ***Leopoldamys sabanus stridens*** | + | + | + |
| 38. | *Rattus exulans concolor* | - | + | + |
| 39. | *Niviventer cremoriventer cremoriventer* | - | + | - |
| 40. | ***Atherurus macrourus tionis*** | + | + | + |
| 41. | *Arctogalidia trivirgata* | - | ? | - |
| 42. | *Arctictis binturong* | ? | - | - |
| 43. | ***Paradoxurus hermaphroditus milleri*** | + | + | + |
| 44. | ***Tragulus napu rufulus*** | + | + | + |
| 45. | *Bos* sp. | - | F | - |
| Total number of spp. | | 34 | 30 | 27 |

Scientific names in bold print indicate subspecies endemic to Pulau Tioman; + - presence of records, - - absence of records, ? - doubtful records, F - feral animals.

APPENDIX 2: The land mammals of Pulau Tioman: a catalogue of specimens at the Raffles Museum of Biodiversity Research, National University of Singapore.

This catalogue lists some 319 specimens of 22 species of land mammals from Pulau Tioman (Pahang, Malaysia) housed at the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research, National University of Singapore. The majority of specimens, largely in the form of dried skins and skulls, have been collected in the period between 1899 and 1927 by Carl Boden Kloss (CBK), E. Seimund (ES), Herbert C. Robinson (HCR), Norman Smedley (NS), W. L. Abbott (WLA), and anonymous collectors from the Raffles Museum (MUS). Most of the specimens listed here have originated from the Juara Bay area, with a few from Kampung Ayer Batang and Sedagong. The ZRC inherited these specimens from the National Museum of Singapore (formerly the Raffles Museum) in 1972, when the Zoology Department at the Museum was being phased out.

The catalogue is presented in the following manner: *Scientific name* (endemic subspecies in bold print, followed by citation of original description); specimen data: ZRC catalogue number; sex of specimen: M - male, F - female, U - unknown; type status if applicable (P = paratype); locality within Pulau Tioman where available; collector/s' initials (see above); date of collection: day.month.year; form of specimen present: s - skin, c - cranium, m - mandible, a - entire specimen in alcohol.

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***Hylomys suillus tionis***

*Hylomys suillus tionis* Chasen, 1940. Bull. Raffles Mus. 15: 12

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.5026 | F | Juara Bay | HCR | 23 Jun.1915 | scm |

The holotype of this subspecies, formerly in the Raffles Museum, has been transferred to the Natural History Museum of London (Gibson-Hill, 1949: 166).

***Crocidura negligens tionis***

*Crocidura tionis* Kloss, 1917. J. Fed. Malay States Mus. 7 (3): 127

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.2407 | F (P) | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.2408 | M (P) | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.7917 | F | Tekek-Juara trail | | Jun.1997 | a |

***Cynocephalus variegatus taylori***

*Galeopterus taylori* Thomas, 1908. J. Fed. Malay States Mus. 2: 102

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.937 | M | Juara Bay | MUS | 12 Sep.1907 | scm |
| ZRC.4.938 | F | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.939 | F | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.940 | F | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.941 | M | Ayer Batang | NS | 26 May.1927 | scm |
| ZRC.4.942 | M | Ayer Batang | NS | 28 May.1927 | scm |
| ZRC.4.996 | M | | | | scm |
| ZRC.4.5577 | F | Juara Bay | HCR | Jul.1915 | cm |

*Pteropus hypomelanus lepidus*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.5545 | M | | | Jun.1916 | s |
| ZRC.4.5745 | M | | | 25 Apr.1927 | a |
| ZRC.4.5746 | M | | | 25 Apr.1927 | a |
| ZRC.4.5747 | M | | | 25 Apr.1927 | a |
| ZRC.4.5748 | M | | | 1927 | |
| ZRC.4.6149 | M | Juara Bay | HCR | 7 Jun.1906 | scm |
| ZRC.4.6150 | M | Juara Bay | HCR | 13 Jun.1906 | s |
| ZRC.4.6151 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.6152 | F | Juara Bay | MUS | 14 Sep.1907 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.6153 | M | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.6154 | F | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.6155 | F | Juara Bay | MUS | 14 Sep.1907 | s |
| ZRC.4.6156 | M | Juara Bay | MUS | 10 Sep.1907 | s |
| ZRC.4.6157 | F | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.6158 | M | Juara Bay | HCR & ES | 15 Jun.1912 | s |
| ZRC.4.6159 | M | Juara Bay | HCR & ES | 15 Jun.1912 | s |
| ZRC.4.6160 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.6161 | M | Juara Bay | HCR | | scm |
| ZRC.4.6173 | M | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.7736 | M | | HCR & ES | Jun.1912 | cm |

*Emballonura monticola monticola*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.6335 | M | Juara Bay | MUS | 10 Sep.1907 | s |
| ZRC.4.6336 | F | | | 15 Sep.1901 | scm |
| ZRC.4.6337 | F | Ayer Batang | | 27 May.1927 | s |
| ZRC.4.6363 | U | Ayer Batang | | 27 May.1927 | a |
| ZRC.4.6364 | U | Ayer Batang | | 28 May.1927 | a |
| ZRC.4.6365 | U | Ayer Batang | | 28 May.1927 | a |
| ZRC.4.6366 | U | | | | a |

*Rhinolophus megaphyllus klossi*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7103 | U | Juara Bay | MUS | 15 Sep.1907 | s |

*Rhinolophus lepidus refulgens*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7117 | M | | CBK | Jul.1916 | a |

*Cheiromeles torquatus torquatus*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7608 | M | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.7609 | F | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.7610 | M | Juara Bay | MUS | 12 Sep.1907 | scm |
| ZRC.4.7611 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.7612 | F | Juara Bay | HCR | 25 Jun.1915 | scm |

***Tupaia glis sordida***

*Tupaia sordida* Miller, 1900. Proc. Wash. Acad. Sci. 2: 231

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.8073 | F | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.8074 | F | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.8075 | F | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.8076 | F | Juara Bay | MUS | 12 Sep.1907 | scm |
| ZRC.4.8077 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.8078 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.8079 | F | Juara Bay | HCR | 4 Jul.1915 | scm |
| ZRC.4.8080 | M | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.8081 | F | Juara Bay | HCR | 9 Jul.1915 | scm |
| ZRC.4.8082 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.8084 | M | | | 28 Jun.1915 | s |
| ZRC.4.8085 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.8086 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8087 | F | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8088 | M | Juara Bay | MUS | 9 Sep.1907 | scm |
| ZRC.4.8089 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.8090 | F | Juara Bay | MUS | 14 Sep.1907 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.8091 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.8092 | F | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.8093 | F | Juara Bay | HCR | 25 Jun.1915 | scm |

*Macaca fascicularis laeta*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.125 | F | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.126 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.127 | F | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.128 | F | | CBK | 20 Jun.1916 | cm |
| ZRC.4.129 | F | Sedagong | NS | 14 May.1927 | scm |
| ZRC.4.130 | F | Sedagong | NS | 20 May.1927 | scm |

***Ratufa bicolor tiomanensis***

*Ratufa tiomanensis* Miller, 1900. Proc. Wash. Acad. Sci. 2: 216

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4317 | M | | | 14 Oct.1900 | scm |
| ZRC.4.4318 | M | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.4319 | F | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.4320 | M | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.4321 | M | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.4322 | F | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.4323 | F | | CBK | 29 Jun.1916 | scm |
| ZRC.4.4324 | M | Sedagong | | 17 May.1927 | scm |
| ZRC.4.4325 | F | Sedagong | | 19 May.1927 | scm |

***Callosciurus notatus tenuirostris***

*Sciurus tenuirostris* Miller, 1900. Proc. Wash. Acad. Sci. 2: 221

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7923 | M | Juara Bay | HCR | 7 Jul.1915 | s |
| ZRC.4.7924 | M | | CBK | 26 Jun.1916 | scm |
| ZRC.4.7925 | M | Juara Bay | NS | 23 May.1927 | scm |
| ZRC.4.7926 | M | Juara Bay | MUS | 9 Sep.1907 | scm |
| ZRC.4.7927 | F | Juara Bay | HCR | 4 Jul.1915 | scm |
| ZRC.4.7928 | M | Juara Bay | HCR | 11 Jul.1915 | scm |
| ZRC.4.7929 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.7930 | M | Juara Bay | MUS | 9 Sep.1907 | scm |
| ZRC.4.7931 | M | Juara Bay | HCR | 9 Jul.1915 | scm |
| ZRC.4.7932 | M | Sedagong | NS | 23 May.1927 | scm |
| ZRC.4.7933 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.7934 | M | | CBK | 21 Jun.1916 | scm |
| ZRC.4.7935 | F | Juara Bay | HCR | 27.6.1915 | scm |
| ZRC.4.7936 | M | | MUS | 9 Sep.1907 | scm |
| ZRC.4.7937 | M | Juara Bay | NS | 23 May.1927 | scm |
| ZRC.4.7938 | F | Juara Bay | HCR | 24 Jun.1915 | s |
| ZRC.4.7939 | F | Juara Bay | MUS | 9 Sep.1907 | sc |
| ZRC.4.7940 | F | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.7941 | M | Ayer Batang | NS | 27 May.1927 | scm |
| ZRC.4.7942 | F | Juara Bay | NS | 23 May.1927 | scm |
| ZRC.4.7943 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.7944 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.7945 | M | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.7946 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7947 | F | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.7948 | F | Juara Bay | HCR & ES | 15 Jun.1912 | s |
| ZRC.4.7949 | M | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.7950 | M | Juara Bay | HCR | 8 Jul.1915 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7951 | F | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.7952 | F | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.7953 | M | Juara Bay | HCR | 7 Jun.1906 | scm |
| ZRC.4.7954 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.7955 | M | Juara Bay | HCR | 25 Jun.1915 | scm |
| ZRC.4.7956 | F | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.7957 | M | Juara Bay | HCR | 15 Jun.1912 | scm |
| ZRC.4.7958 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7959 | F | Juara Bay | HCR | 9 Jun.1906 | s |
| ZRC.4.7960 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.7961 | F | Juara Bay | HCR | 2 Jul.1915 | scm |

***Callosciurus nigrovittatus microrhynchus***

*Sciurus (bilimitatus) microrhynchus* Kloss, 1908. J. Fed. Malay States Mus. 2: 144

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.7962 | F | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.7963 | F | Sedagong | NS | 23 May.1927 | scm |
| ZRC.4.7964 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7965 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.7966 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.7967 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.7968 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7969 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.7970 | F | | | vii.1915 | scm |
| ZRC.4.7971 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.7972 | F | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.7973 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.7974 | F | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.7975 | F | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.7976 | F | Sedagong | NS | 21 May.1927 | scm |
| ZRC.4.7977 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.7978 | M | | CBK | 2 Jul.1916 | scm |
| ZRC.4.7979 | M | Sedagong | NS | 23 May.1927 | scm |
| ZRC.4.7980 | M | Juara Bay | HCR | 7 Jul.1915 | s |
| ZRC.4.7981 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.7982 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.7983 | M | Ayer Batang | NS | 28 May.1927 | s |
| ZRC.4.7984 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7985 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.7986 | F | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.7987 | M | Juara Bay | NS | 23 May.1927 | scm |

***Sundasciurus tenuis tiomanicus***

*Tomeutes tenuis tiomanicus* Robinson, 1917. J. Fed. Malay States Mus. 7 (3): 103.

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.3053 | F (P) | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.3054 | M (P) | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.3055 | F (P) | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.3056 | F (P) | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.3057 | F (P) | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.3058 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.3059 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.3060 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.3061 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.3062 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.3063 | M | Juara Bay | HCR | 30 Jun.1915 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.3064 | F | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.3065 | M | | HCR | 11 Jul.1915 | scm |
| ZRC.4.3066 | M | Sedagong | NS | 17 May.1927 | scm |
| ZRC.4.3067 | F | Sedagong | NS | 16 May.1927 | scm |
| ZRC.4.3073 | F | Juara Bay | HCR | 24 Jun.1915 | cm |
| ZRC.4.3074 | M | Juara Bay | MUS | 13 Sep.1907 | cm |
| ZRC.4.3075 | M | Juara Bay | MUS | 9 Sep.1907 | cm |
| ZRC.4.3077 | F | Sedagong | NS | 21 May.1927 | cm |
| ZRC.uncat. | M | Juara Bay | MUS | 9 Sep.1907 | s |
| ZRC.uncat. | M | Juara Bay | MUS | 13 Sep.1907 | s |
| ZRC.uncat. | M | Juara Bay | MUS | 13 Sep.1907 | s |

***Lariscus insignis fornicatus***

*Lariscus insignis fornicatus* Robinson, 1917. J. Fed. Malay States Mus. 7 (3): 102.

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.3078 | M (P) | Juara Bay | CBK | 23 Jun.1916 | scm |
| ZRC.4.3079 | M (P) | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.3080 | F | Sedagong | NS | 21 May.1927 | s |
| ZRC.4.3081 | M | Sedagong | NS | 24 May.1927 | scm |

***Rhinosciurus laticaudatus robinsoni***

*Rhinosciurus robinsoni* Thomas, 1908. J. Fed. Malay States Mus. 2: 104

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4664 | M (P) | Juara Bay | HCR | 9 Jun.1906 | scm |
| ZRC.4.4665 | F (P) | Juara Bay | HCR | 6 Jun.1906 | scm |
| ZRC.4.4666 | F (P) | Juara Bay | HCR | 3 Jun.1906 | s |
| ZRC.4.4667 | F | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.4668 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.4669 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.4670 | F | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.4671 | F | Juara Bay | HCR | 30 Jun.1915 | sc |
| ZRC.4.4672 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.4673 | F | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.4674 | F | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.4675 | F | | MUS | 14 Sep.1907 | scm |
| ZRC.4.4676 | F | | | 2 Jul.1915 | s |
| ZRC.4.4677 | M | Sedagong | NS | 23 May.1927 | scm |

*Petaurista petaurista melanotus*

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4462 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.4484 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.4485 | U | | HCR | | cm |

***Rattus tiomanicus tiomanicus***

*Mus tiomanicus* Miller, 1900. Proc. Wash. Acad. Sci. 2: 209

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.8040 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8041 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8042 | F | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8043 | F | Juara Bay | MUS | 19 Sep.1907 | scm |
| ZRC.4.8044 | F | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.8045 | M | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.8046 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.8047 | F | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.8048 | F | | HCR | 14 Jun.1906 | scm |
| ZRC.4.8049 | F | Juara Bay | HCR | 3 Jul.1915 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.8050 | M | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.8051 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8052 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.8053 | F | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.8054 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.8055 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.8056 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8057 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.8058 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.8059 | M | | CBK | 30 Jun.1916 | scm |
| ZRC.4.8060 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8061 | M | Juara Bay | MUS | 9 Sep.1907 | scm |
| ZRC.4.8062 | F | Sedagong | NS | 16 May.1927 | scm |
| ZRC.4.8063 | F | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8064 | M | | WLA | 2 Oct.1899 | cm |
| ZRC.4.8065 | M | | WLA | 1 Oct.1899 | cm |

***Maxomys surifer binominatus***

*Mus (surifer) microdon* Kloss, 1908. J. Fed. Malay States Mus. 2: 145 (name already occupied)
*Epimys surifer binominatus* Kloss, 1915. J. Fed. Malay States Mus. 5 (4): 223 (replacement name)

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4552 | F (P) | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.4553 | M (P) | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.4554 | M (P) | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.4555 | F (P) | Juara Bay | MUS | 14 Sep.1907 | scm |
| ZRC.4.4556 | F (P) | Juara Bay | MUS | 9 Sep.1907 | scm |
| ZRC.4.4557 | F (P) | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.4558 | M | Juara Bay | HCR | 11 Jun.1906 | scm |
| ZRC.4.4559 | F | Juara Bay | HCR | 25 Jun.1915 | scm |
| ZRC.4.4560 | F | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.4561 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4562 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4563 | M | Juara Bay | HCR | 30 Jul.1915 | scm |
| ZRC.4.4564 | M | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.4565 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.4566 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.4567 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.4568 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.4569 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.4570 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.4571 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.4572 | F | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4573 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4574 | M | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.4575 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.4576 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4577 | F | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.4578 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.4579 | M | Juara Bay | HCR | 28 Jun.1915 | scm |
| ZRC.4.4580 | M | Juara Bay | HCR | 25 Jun.1915 | scm |
| ZRC.4.4581 | F | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.4582 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.4583 | F | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.4584 | M | | | 20 Jun.1916 | s |
| ZRC.4.4585 | M | | CBK | 20 Jun.1916 | scm |
| ZRC.4.4586 | F | | CBK | 20 Jun.1916 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4587 | M | | CBK | 25 Jun.1916 | scm |
| ZRC.4.4588 | M | | CBK | 27 Jun.1916 | scm |
| ZRC.4.4589 | F | | CBK | 30 Jun.1916 | scm |
| ZRC.4.4590 | M | | CBK | 30 Jun.1916 | scm |
| ZRC.4.4591 | M | | CBK | 21 Jun.1916 | scm |
| ZRC.4.4592 | F | | CBK | 21 Jun.1916 | scm |

***Leopoldamys sabanus stridens***

*Mus stridens* Miller, 1903. Smithsonian misc. Collns. 45: 28

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.8003 | M | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.8004 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.8005 | F | Sedagong | NS | 13 May.1927 | scm |
| ZRC.4.8006 | F | Sedagong | NS | 15 Apr.1927 | scm |
| ZRC.4.8007 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.8008 | M | Sedagong | NS | 16 May.1927 | scm |
| ZRC.4.8009 | F | Juara Bay | MUS | 10 Sep.1907 | scm |
| ZRC.4.8010 | M | | CBK | 25 Jun.1916 | scm |
| ZRC.4.8011 | M | Sedagong | NS | 14 May.1927 | scm |
| ZRC.4.8012 | F | | CBK | 24 Jun.1916 | scm |
| ZRC.4.8013 | M | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.8014 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.8015 | M | Juara Bay | HCR | 27 Jun.1915 | scm |
| ZRC.4.8016 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.8017 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8018 | M | | | vi.1915 | s |
| ZRC.4.8019 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.8020 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.8021 | F | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.8022 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8023 | M | Juara Bay | HCR | 22 Jul.1915 | scm |
| ZRC.4.8024 | M | Juara Bay | HCR | 22 Jun.1915 | scm |
| ZRC.4.8025 | F | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.8026 | M | Juara Bay | MUS | 11 Sep.1907 | scm |
| ZRC.4.8027 | M | Juara Bay | HCR | 3 Jul.1915 | scm |
| ZRC.4.8028 | F | | CBK | 24 Jun.1916 | scm |
| ZRC.4.8029 | M | Juara Bay | HCR | 4 Jul.1915 | scm |
| ZRC.4.8030 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8031 | M | Juara Bay | HCR | 24 Jun.1915 | scm |
| ZRC.4.8032 | M | | CBK | 22 Jun.1916 | scm |
| ZRC.4.8033 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8034 | F | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.8035 | F | Sedagong | NS | 14 May.1927 | scm |
| ZRC.4.8036 | F | | CBK | 27 Jun.1916 | scm |
| ZRC.4.8037 | M | Sedagong | NS | 16 May.1927 | scm |
| ZRC.4.8038 | F | Sedagong | NS | 13 May.1927 | scm |
| ZRC.4.8039 | F | Juara Bay | MUS | 9 Sep.1907 | scm |

***Atherurus macrourus tionis***

*Atherurus tionis* Thomas, 1908. J. Fed. Malay States Mus. 2: 105

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.1578 | F (P) | Juara Bay | HCR | 13 Jun.1906 | s |
| ZRC.4.1578 | F | | HCR | 15 Jun.1906 | s |
| ZRC.4.1579 | F | | CBK | 25 Jun.1916 | scm |
| ZRC.4.1580 | M | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.1581 | F | Juara Bay | HCR | 27 Jun.1915 | scm |

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.1582 | F | Juara Bay | HCR | 1 Jul.1915 | scm |
| ZRC.4.1591 | M | | | Jul.1915 | s |

According to van Weers (1977: 210), the skull of ZRC.4.1578 is at the Natural History Museum in London under catalogue number BMNH 8.1.25.52.

***Tragulus napu rufulus***

*Tragulus rufulus* Miller, 1900. Proc. Wash. Acad. Sci. 2: 227

| | | | | | |
|---|---|---|---|---|---|
| ZRC.4.4711 | M | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.4712 | M | Juara Bay | HCR | 26 Jun.1915 | scm |
| ZRC.4.4713 | M | Juara Bay | HCR | 23 Jun.1915 | scm |
| ZRC.4.4714 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.4715 | M | Juara Bay | HCR | 2 Jul.1915 | scm |
| ZRC.4.4716 | M | | CBK | 23 Jun.1916 | scm |
| ZRC.4.4717 | M | | CBK | 28 Jun.1916 | scm |
| ZRC.4.4718 | M | Juara Bay | HCR | Jul.1915 | scm |
| ZRC.4.4719 | F | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.4720 | M | Juara Bay | HCR | 29 Jun.1915 | scm |
| ZRC.4.4721 | M | Juara Bay | HCR | 30 Jun.1915 | scm |
| ZRC.4.4722 | M | | CBK | 30 Jun.1916 | scm |
| ZRC.4.4759 | F | | | Jul.1915 | scm |
| ZRC.4.4760 | M | Juara Bay | HCR | 6 Jun.1906 | s |
| ZRC.4.4903 | F | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.4904 | M | Juara Bay | HCR & ES | 15 Jun.1912 | scm |
| ZRC.4.4905 | M | Juara Bay | MUS | Sep.1907 | cm |
| ZRC.4.4906 | F | Juara Bay | HCR | 15 Jun.1912 | cm |
| ZRC.4.4969 | U | | | | cm |