

# The diversity and status of the civets (Viverridae) of Singapore

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## Abstract

A review of the civet records from Singapore confirms the existence of four species (Small-toothed Palm Civet *Arctogalidia trivirgata*, Common Palm Civet *Paradoxurus hermaphroditus*, Malay Civet *Viverra zibetha* and Large Indian Civet *V. zibetha*) out of the nine hitherto recorded; it is not totally clear that the two *Viverra* species are native. The status of Masked Palm Civet *Paguma larvata* is indeterminate, while the natural occurrence of Binturong *Arctictis binturong*, Otter Civet *Cynogale bennettii*, Small Indian Civet *Viverricula indica* and Large Spotted Civet *Viverra megaspila* seems doubtful.

**Keywords:** biodiversity, historical ambiguity, recent field records, Viverridae

## Introduction

The family Viverridae (civets) consists of small- to medium-sized carnivores that are widely distributed in the warmer parts of the Old World. Ten species of civets are known from the Malay Peninsula (Francis 2008), the strip of land at the south-eastern corner of the Asian continent which is also part of the Sunda Shelf, and is largely occupied by Peninsular Malaysia and southern Thailand. At the southern tip of the Malay Peninsula is Singapore (1°20'N, 103°50'E), a small country where nine species of civets have been reported, although specific records of most are not readily available.

Singapore is separated from the Asian mainland by the Straits of Johor, a channel of seawater that is, at its narrowest point, only 600 m wide. The main island of Singapore and sixty smaller islands make up an area of 710 km<sup>2</sup> (NParks 2010). Bukit Timah Hill, its highest point, is 164 m above sea level. The climate is equatorial and has a mean annual rainfall of 2,375 mm, never falling below a mean of 100 mm in the driest months (Corlett 1992). The area was largely covered in diverse lowland tropical rainforest until the arrival of Sir Stamford Raffles in 1819 (Corlett 1992, Turner 1993), followed by the development of Singapore into a trading post, and now a metropolitan city. Currently, only 2.8 km<sup>2</sup> of primary forest remain (Corlett 1997), in the Bukit Timah Nature Reserve and the Central Catchment Nature Reserve. These rainforest nature reserves are protected natural areas, and along with Sungei Buloh Wetland Reserve and Labrador Nature Reserve make up 33.26 km<sup>2</sup> (about 4.7%) of Singapore's total land area (NParks 2010).

The Viverridae of Singapore has been reported by Cantor (1846), Ridley (1895), Chasen (1924), Harrison (1974), Medway (1983), Yang *et al.* (1990), Teo & Rajathurai (1997), Baker & Lim (2008), Lim *et al.* (2008) and Lim & Ou Yang (2012). This article is a review of their diversity and local status in the country.

## Species list

The following records are from published literature (including specimen records), preserved specimens largely in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research at the National University of Singapore, and observations and photographs submitted to the records database of the Vertebrate Study Group of The Nature Soci-

ety (Singapore). Malay words are used in locality names with Malay-English translations as follows: Bukit – Hill; Jalan – Road; Kampung – Village; Pulau – Island; Sungei – River or Stream. Taxonomy and nomenclature follow Jennings & Veron (2009). Sightings were of single animals except where stated. Individual records are given in the Appendix and locations are marked on Fig. 1.

### Binturong *Arctictis binturong* (Raffles)

Subspecies: *Arctictis binturong binturong* (Raffles)

*Arctictis binturong* – Harrison 1974: 229 (Singapore: not recorded for many years), Baker & Lim 2008: 167 (Singapore: extinct). *Arctitis [sic] binturong binturong* – Yang *et al.* 1990: 14, 21 (Singapore: indeterminate status).

Harrison (1974) suggested that the type specimen of Binturong, described by Raffles, may have been from Singapore, and claimed that the species had not been recorded there for many years. However, in the original description, Raffles (1821: 253) stated that the animal (as *Viverra? binturong*) was “found at Malacca”, which is not in Singapore, and at that time might even have referred to an origin from other parts of the Malay Peninsula: Malacca was a major trade centre of the region at that time (Kennedy 1993) and it is therefore possible that the specimen came from a market. If it had been from Singapore, Raffles would have written thus, as he did for *Simia maura?* (= *Presbytis femoralis*), *Tupaia ferruginea* (= *Tupaia glis*) and *Sciurus affinis* (= *Ratufa affinis*). The reasoning behind Harrison's claim is unknown, and there is apparently no historical record of Binturong in Singapore. However, escapees, such as that listed in the Appendix, have been recorded (Yang *et al.* 1990).

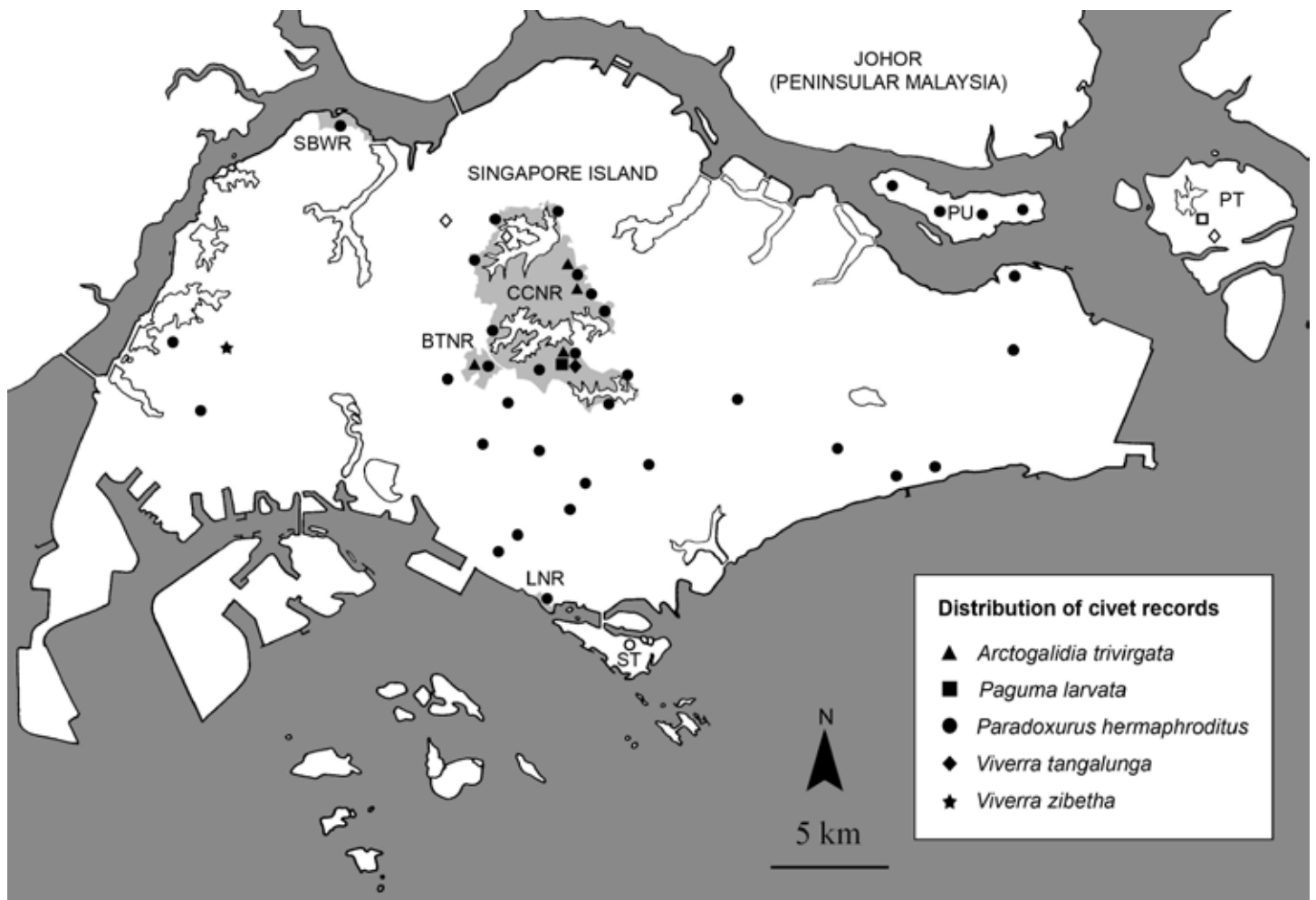
### Small-toothed Palm Civet *Arctogalidia trivirgata* (Gray)

Subspecies: *Arctogalidia trivirgata trivirgata* (Gray) (see Corbet & Hill 1992: 212)

*Paguma trivirgata* – Cantor 1846: 201 (Singapore).

*Arctogalidia trivirgata* – Chasen 1924: 83, Harrison 1974: 230 (seemed to occur in Singapore), Corbet & Hill 1992: 212, Baker & Lim 2008: 152 & 163 (Singapore: rare and restricted to a few areas), Lim *et al.* 2008: 200 (Singapore: ‘critically endangered’, confined to Bukit Timah and Central Catchment Nature Reserves).

*Arctogalidia trivirgata sumatrana* – Medway 1983: 94, Yang *et al.* 1990: 14 & 21 (Singapore: indeterminate status).



**Fig. 1.** Singapore, with known locations of civet records. Solid shapes represent confirmed, hollow shapes unconfirmed, records. Offshore islands: PU = Pulau Ubin, PT = Pulau Tekong, ST = Sentosa; Nature Reserves: BTNR = Bukit Timah Nature Reserve, CCNR = Central Catchment Nature Reserve, LNR = Labrador Nature Reserve, SBWR = Sungei Buloh Wetland Reserve.



**Fig. 2.** The arboreal Small-toothed Palm Civet *Arctogalidia trivirgata* has only been recorded in Singapore by night-transsect spotlighting (photo: Celine Low).

**Museum specimens**

- Singapore – female acquired from C. O. Hagerdon on 15 March 1922 (ZRC 4.1293; Chasen 1924: 83).

- Singapore – male presented by C. O. Hagerdon on 23 November 1922 (ZRC 4.1294; Chasen 1924: 83).

Chasen (1924) cited two specimens in the collection of the Raffles Museum and mentioned another three local individuals that were brought to the museum within two years. The fate of the latter is not clear. This species appears to be highly vocal and is known to make a loud chirping call. It appears to be confined in Singapore to the Bukit Timah and Central Catchment Nature Reserves, where it has been widespread but rarely observed in the past two decades: the records in the Appendix are the total from at least 300 hours of spotlighting surveys (Fig. 2). In Singapore, this species is regarded as critically endangered by Lim *et al.* (2008).

**Masked Palm Civet *Paguma larvata* (Smith)**

Subspecies: *Paguma larvata annectens* (Robinson & Kloss; also see Corbet & Hill 1992: 210)

*Paguma leucomystax* – Cantor 1846: 200 (Singapore), Chasen 1924: 82–83 (Singapore: occurrence seemed suspicious).

*Paguma larvata* – Harrison 1974: 228 (Singapore: apparently used to occur at the turn of the 20th century), Baker & Lim 2008: 163 (Singapore: rare and restricted to a few areas?),

Lim *et al.* 2008: 200 (Singapore: 'critically endangered'), Patou *et al.* 2009: 220 (specimen from Singapore Zoo).

*Paguma larvata jourdainii* – Medway 1983: 93 (presence of endemic [*sic*] population in Singapore not confirmed), Yang *et al.* 1990: 14 & 21 (Singapore: occurrence doubtful), Teo & Rajathurai 1997: 370 (MacRitchie and Pulau Tekong).

Chasen (1924) cited (as *P. leucomystax*), with suspicion, a specimen in the Raffles Museum labelled as having been taken in Singapore in 1895. However, this specimen could not be located at the present and may have been lost. Patou *et al.* (2009: 220) cited a 'Singapore' specimen from the Singapore Zoo; this was most probably a captive-born animal imported from the Taipei Zoo (Razak Jaffar, Wildlife Reserves Singapore, *in litt.* 2012). The 1990 record from Pulau Tekong cannot be confirmed and there is no way to ascertain if the 1994 sighting is of a former captive animal. As there is neither recent proof of its wild occurrence in Singapore, nor indisputable historical record there, the national status of Masked Palm Civet should be considered indeterminate.

### Common Palm Civet *Paradoxurus hermaphroditus* (Pallas)

Subspecies: uncertain pending a thorough taxonomic revision. Patou *et al.* (2010) proposed that the species as conventionally constituted may be paraphyletic, indicating that it perhaps should be split into at least three distinct species. The Singapore population falls into the group that occurs in the lowlands (under 200 m) of Indochina, the Malay Peninsula, Sumatra and Java. *Paradoxurus* [*sic*] *musanga* – Cantor 1846: 201 (Singapore).

*Viverra malaccensis* – Ridley 1895: 92 (Singapore; misidentification).

*Paradoxurus hermaphroditus* – Chasen 1924: 82, Chuang 1973: 3, Harrison & Tham 1973: 252, Harrison 1974: 227, Corlett & Lucas 1995: 98 (Bukit Timah Nature Reserve), Chua 2000: 109 & 134 (Pulau Ubin), Anonymous 2003: 25 & 92 (Sungei Buloh Wetland Reserve), Baker & Lim 2008: 152 & 163 (Singapore: widespread and uncommon), Chua 2010: 137 (Sungei Buloh Wetland Reserve).

*Paradoxurus hermaphroditus musanga* – Medway 1983: 93, Yang *et al.* 1990: 14 & 21 (Singapore: common), Teo & Rajathurai 1997: 369 (Bukit Timah and Central Catchment Nature Reserves).

### Museum specimens

- Thomson Road, reservoir – specimen presented by A. A. Day on 26 July 1921 (ZRC 4.1415).
- Singapore Island – male acquired by 'Purdy' on 3 March 1927 (ZRC 4.1392).
- Singapore – specimen obtained by 'Kadir' on 4 January 1944 (ZRC 4.1393).
- Ulu Pandan, off Holland Road – female road-kill collected by H. T. W. Tan on 6 February 2008 (ZRC 4.8182; also see Appendix).

According to Harrison & Tham (1973: 252), *Paradoxurus hermaphroditus* was "caught in the jungles of Singapore and neighbouring countries and...used for human consumption by those who believe that its meat possesses invigorating properties". However, this practice does not appear to be prevalent in recent years, at least in Singapore. Common Palm Civet frequently lives in and around human habitation, partic-

ularly in rural and suburban areas where there are fruit trees for it to feed in, and roof spaces into which it can retire by day (Harrison 1974, Baker & Lim 2008, Xu 2010).

This close association with people has given rise to human-civet conflict in some residential areas. From being a subject of gastronomic interest, this animal has, in recent years, been viewed as a nuisance by some. Not many people are tolerant of thumping sounds (of civets running) on the ceiling, the dislodging of roof tiles, or of having their fruit trees raided (by civets). As a result, many of these animals were trapped by residents (Xu 2010).

Some civets caught at suburban Siglap in 2009 and early 2010 were translocated to the Bukit Timah and Central Catchment Nature Reserves (T. M. Leong verbally 2012), Labrador Nature Reserve and other wooded but non-protected areas. This had apparently led to a rise in the sightings of this species in the nature reserves over those two years. The concentration of sightings at Pulau Ubin in 1999 and 2000 was, however, due to an intensive wildlife survey conducted by the National Parks Board (NParks) on the island during that period. Despite being by far the most commonly observed civet in Singapore, it is regarded as uncommon at the national level (Baker & Lim 2008).

### Otter Civet *Cynogale bennettii* Gray

Subspecies: none recognised.

*Cynogale bennetti* [*sic*] – Harrison 1974: 231 (Singapore specimen at the Natural History Museum in London).

*Cynogale bennettii* – Yang *et al.* 1990: 15 & 21 (Singapore: occurrence doubtful), Baker & Lim 2008: 170 (Singapore: occurrence doubtful).

Apart from an old specimen without precise collection data at the Natural History Museum in London, there is no other record of this rare civet in Singapore. Meiri (2005) included the specimen in his publication as "highly likely" (p. 21) to have been obtained in Singapore, because it did not seem odd according to the species's distribution (S. Meiri *in litt.* 2012), despite having at the same time noted (for another specimen labelled from Singapore, of Indian Grey Mongoose



Fig. 3. Camera-trap image of a Malay Civet *Viverra zibetha* attracted to chicken carcass in the Central Catchment Nature Reserve (photo courtesy of Norman Lim and Ou Yang Xiuling).

*Herpestes edwardsii*) that “Singapore is and has been . . . a major trade center, and thus records of supposedly Singaporean specimens should be taken with a grain of salt”. Furthermore, from specimen lists and field records (Veron *et al.* 2006), Otter Civet appears to occur naturally in low numbers and other than the lone Singaporean specimen in question, has not been recorded from other small islands. The evidence suggests its occurrence in Singapore is doubtful.

### Large-spotted Civet *Viverra megaspila* Blyth

Subspecies: none recognised.

*Viverra megaspila* – Chasen 1924: 82 (refers to Singapore material identified as *V. tangalunga* by Cantor 1846), Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: doubtful occurrence).

*Viverra megaspila megaspila* – Medway 1983: 90 (Singapore record considered tentative), Yang *et al.* 1990: 14 & 21 (Singapore: doubtful occurrence).

There is no actual record of *V. megaspila* in Singapore. Chasen (1924) was of the opinion that Cantor’s (1846) record of *V. tangalunga* from Singapore could be *V. megaspila* (because the two species were formerly confused). However, because Chasen did not even see Cantor’s material, there is no support for his referral of Cantor’s record to *V. megaspila*. Conversely, Lim & Ou Yang (2012) reported a specimen from Singapore labelled as *V. megaspila* deposited at the Muséum National d’Histoire Naturelle in Paris, France, under catalogue number MNHN CG 1970-369, which was later determined to be *V. tangalunga*. In the Malay Peninsula, *V. megaspila* is uncommon and there are apparently no records of it south of Perak (Jennings & Veron 2011).

### Malay Civet *Viverra tangalunga* Gray

Subspecies: *Viverra tangalunga tangalunga* Gray

*Viverra tangalunga* – Cantor 1846: 197 (Singapore), Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: indeterminate status), Jennings & Veron 2011: 319, Lim & Ou Yang 2012: 79 (camera-trapped at MacRitchie forest).

*Viverra tanhalunga* [sic] – Chuang 1973: 3.

*Viverra tangalunga tangalunga* – Medway 1983: 90, Yang *et al.* 1990: 13 & 21 (Singapore: indeterminate status), Teo & Rajathurai 1997: 370 (Central Catchment Nature Reserve, ?Pulau Tekong).

No report of *V. tangalunga* from Singapore before January 2012 cited diagnostic characters or was photographed. All these should therefore be treated as unconfirmed, possibly being misidentified *V. zibetha*. As these two species superficially resemble each other, they can easily be confused with each other in the field. Teo & Rajathurai (1997) were of the opinion that the then recent record from Pulau Tekong may have been of *V. zibetha*.

The record from the Central Catchment Nature Reserve in the early 1990s (Teo & Rajathurai 1997) seems suspicious. It was reported by a staff of the Singapore Zoo, and the timing coincided with the donation to the zoo of a *V. zibetha* trapped near Jalan Bahar (see below) in May 1990.

The paucity of confirmed records of this rather large and conspicuous civet, which shows a degree of tolerance to disturbed habitats (Colón 2002, Jennings *et al.* 2006) places some doubt on its natural occurrence in Singapore. However, a cam-

era-trap survey of the Bukit Timah and Central Catchment Nature Reserves from September 2011 to January 2012 yielded one confirmed record of *V. tangalunga* (Lim & Ou Yang 2012; Fig. 3). Perhaps the individual was a former captive, but if it is indeed part of a native population, the species in Singapore should be regarded as rare, possibly critically endangered. Lim & Ou Yang (2012) also reported a specimen of *V. tangalunga* from Singapore, catalogued by the Muséum National d’Histoire Naturelle, Paris, in 1969 as MNHN CG 1970-369. The label lacks precise information on the collection location and date, and the collector. As with all civet specimens from Singapore, caution is needed over its origin (see discussion).

### Large Indian Civet *Viverra zibetha* Linnaeus

Subspecies: *Viverra zibetha sigillata* Robinson & Kloss

*Viverra zibetha* – Cantor 1846: 197 (Singapore), Chasen 1924: 81–82 (five specimens taken between 1908 and 1922), Chuang 1973: 3, Harrison 1974: 225 (seemed to be the commonest civet in Singapore), Corbet & Hill 1992: 205, Baker & Lim 2008: 170 (Singapore: indeterminate status), Lim *et al.* 2008: 201 (Singapore: ‘critically endangered’), Jennings & Veron 2011: 318.

*Viverra zibetha pruinosa* – Medway 1983: 90, Yang *et al.* 1990: 13 & 21 (Singapore: indeterminate status).

### Museum specimens

- Singapore – female acquired on 30 November 1917 (ZRC 4.1470; Chasen 1924: 81).
- Changi 10th mile – female obtained on 5 November 1924 (ZRC 4.1471).
- Bukit Timah – female obtained on 23 February 1925 (ZRC 4.1472).
- Bukit Timah – two skins acquired in 1934 (ZRC 4.1473, 1474).
- Bukit Timah – male acquired on 7 February 1935 (ZRC 4.1475).
- Singapore – male obtained on 19 February 1941 (ZRC 4.1463).

Chasen (1924: 82) reported that *V. zibetha* was “commonly imported” into Singapore “and no doubt escape[s] from captivity at times”. He cited three Singapore specimens at the Raffles Museum taken in 1908, 1917 and 1922, respectively. He also mentioned two other individuals that were locally obtained in 1921 and 1922. Of these, only that from 1917 (ZRC 4.1470) remains in the collection today. Five specimens taken during 1924–1941 were subsequently added. These specimens could have given Harrison (1974) the impression that *V. zibetha* was the commonest civet in Singapore. Indeed, there were then far fewer specimens of *Paradoxurus hermaphroditus* and *Arctogalidia trivirgata* in the collection of the Raffles Museum. In view of Chasen’s note that this is a commonly traded species, whether or not it is indigenous needs to be determined.

According to Harrison (1974: 225), *V. zibetha* is partly associated with human activities, and “may have spread down to the Malay Peninsula with human cultivation”. Indeed, the sole recent confirmed Singapore record, verified from a published photograph, was of an animal trapped in a farming area in 1990. Its wild or captive origin cannot be determined. This species is restricted to continental Southeast Asia, north to

southern China and west to northern India; Singapore would be the southern limit of its range (Corbet & Hill 1992), whereas *V. tangalunga*, confined to insular Southeast Asia except for occurrence on the Malay Peninsula (Corbet & Hill 1992), appears better adapted to the dense, humid rainforest habitat prevalent in the region.

Apart from the one individual trapped at Jalan Bahar, there were also unconfirmed sightings of *V. zibetha* from Central Catchment Nature Reserve, Pulau Tekong, Lornie Road and Old Holland Road (Lim *et al.* 2008). Because there are no confirmed records apart from the one trapped in 1990, its national status is considered indeterminate (Baker & Lim 2008) or critically endangered (Lim *et al.* 2008).

### Small Indian Civet *Viverricula indica*

#### (E. Geoffroy Saint-Hilaire)

Subspecies: *Viverricula indica klossi* Pocock

*Viverricula malaccensis* – Cantor 1846: 199 (Singapore), Ridley 1895: 92 (Singapore: but name incorrectly applied to information relating to Common Palm Civet *Paradoxurus hermaphroditus*).

*Viverricula indica* – Chuang 1973: 3, Harrison 1974: 226, Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: indeterminate status).

*Viverricula indica indica* – Yang *et al.* 1990: 14 & 21 (Singapore: doubtful occurrence).

We are aware of no Singapore specimen of *V. indica* in a museum, nor any recorded sighting in Singapore. Considering that *V. indica* is, when present, relatively easily camera-trapped and spotlighted (e.g. Su Su 2005, Kumara & Singh 2007, Holden & Neang 2009), it is unlikely to remain unnoticed in Singapore if extant. Furthermore, this species occurs, perhaps predominantly, in areas of heavy habitat degradation and human activity (e.g. Lekagul & McNeely 1988, Su Su 2005). Thus, it would be unlikely to have escaped observation or collection had it been present in Singapore. Therefore, its occurrence here is highly doubtful. Although Chuang (1973) cited it as one of the common civets in Singapore, it is likely that, as with Ridley (1895), he had misidentified *Paradoxurus hermaphroditus*.

## Discussion

Nine of the ten species of civets accepted for Peninsular Malaysia by Francis (2008) have been reported from Singapore, the exception being Banded Civet *Hemigalus derbyanus*. There are confirmed records of wild-living animals of four species: *Arctogalidia trivirgata*, *Paradoxurus hermaphroditus*, *Viverra tangalunga* and *V. zibetha*. Two (*A. trivirgata* and *V. tangalunga*) are confined to the Bukit Timah and Central Catchment Nature Reserves; the third (*P. hermaphroditus*), which adapts to disturbed habitats and human habitation, faces conflict from some humans who do not welcome it in their homes. *Viverra zibetha* has not been seen locally for at least 18 years. A confirmed *Paguma larvata* sighting from the Central Catchment Nature Reserve may have involved an escaped captive. Although this cannot be proven, subsequent surveys have not found the species, and the only other recent report, from Pulau Tekong, is unconfirmed. Moreover, truly wild origin of the two *Viverra* species is not totally certain (see species accounts).

The occurrence of the remaining four species is doubtful. There is no proof that *Arctictis binturong* ever occurred naturally, but it inhabits islands in the Riau Archipelago, such as Bintan and Kundur (Corbett & Hill 1992), which are near Singapore. Hence, there may be a possibility that the species was present in Singapore, but extirpated before proper mammal records or collections began. Records of *Cynogale bennettii* and *Viverricula indica* may have been based on specimens acquired through trade. Singapore was a bustling trading centre and imported specimens may have been purchased in the market, yet labelled as implying a Singapore origin. *Viverra megaspila* was included because it was assumed, apparently without strong foundation, to be the correct identity of an early record of *V. tangalunga*. The inclusion of the species with doubtful Singapore occurrence in previous literature as locally extinct (Yang *et al.* 1990, Baker & Lim 2008) may have resulted in inaccuracies in estimates of extinction rates in Singapore by authors such as Brook *et al.* (2003). This does not reduce the severity of the extinction threats that civets in Singapore face today.

With the exception of *P. hermaphroditus*, which adapts readily to human habitation, the survival of most Singaporean species of civets depends, to varying degrees, on the availability of forest. Although the total green cover in Singapore is 47%, most of it is not rainforest (Turner 1993). The scarcity of extensive tall forest may have led to the possible extinction of forest-dependent species and contributed to the apparent rarity of *Arctogalidia trivirgata* and *V. tangalunga*, which may have lower densities in disturbed forest habitats (Heydon & Bulloh 1996, Lekagul & McNeely 1988, Colón 2002).

Trade in civets could have been lucrative in the past, given their culinary use (Cantor 1846, Chasen 1924, Harrison & Tham 1973). Their kittens were probably in demand as pets. Civets were also a feature in the perfume industry, which uses civet musk. Being a major trading centre, many species of animals caught from surrounding areas passed through Singapore. Some may have escaped from captivity (Chasen 1924) while others may have been purchased locally and then labelled as having been obtained in the country. Old museum specimens bearing such labels and without detailed collection data should be treated with a large dose of suspicion (see *Cynogale bennettii*, above).

Until the past two decades, there was no concerted effort to survey wild mammals in Singapore. Most of the recent records of wild mammals, including civets, are from surveys in the Bukit Timah and Central Catchment Nature Reserves (Teo & Rajathurai 1997, Leong & Gan 2012), roadkills, and academic research (Chua 2009, Xu 2010, Fung 2011). More recently, camera-traps have been used, in the Bukit Timah and Central Catchment Nature Reserves, Western Catchment, Pulau Ubin and Pulau Tekong (see Lim & Ou Yang 2012), resulting in the first confirmed record of *V. tangalunga* in Singapore.

Still, little is known about civet ecology in Singapore. Other than the presence and distribution of species presented here, and the diet of *P. hermaphroditus* (Xu 2010, Fung 2011), information is scant. Many civets are at least partly arboreal, but conventional use of camera-traps only records civets on or near the ground, thereby missing largely arboreal species such as *Arctogalidia trivirgata* (Walston & Duckworth 2003, Hunter & Barrett 2011). Hence, other techniques such as spotlighting

and baited cage-traps may be necessary to understand all species' local status.

This update of the status of civets in Singapore highlights the importance of careful examination and critical evaluation of museum specimen labels and original literature: doubtful records sometimes become embedded in 'common knowledge' as valid. Apart from confusing the understanding of the status and distribution of individual species, such confusions may have erroneously inflated the extinction rate of mammals in Singapore. Further research in the ecology and behaviour of civets in Singapore is vital in understanding the autecology and conservation of nationally threatened species.

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## Appendix. Civet records from Singapore

Location	Date	Time	Habit when observed	Observer/Reference
<b><i>Arctictis binturong</i></b>				
Bukit Panjang: Cheng Hua Garden	May 2004	N.A.	Fine adult, believed to be a zoo escapee, was caught and returned to the Singapore Zoo	<i>The Straits Times</i> 8 May 2004: 6
<b><i>Arctogalidia trivirgata</i></b>				
Bukit Timah Nature Reserve	Between Jun 1993 and Jul 1997	Night	Two unconfirmed records of probably the same individual. "calling incessantly [from trees], sounding like Slender Squirrel <i>Sundasciurus tenuis</i> , but much louder and exaggerated"	Teo & Rajathurai 1997
Central Catchment Nature Reserve: Nee Soon sector	1997	Night	Two observed	S. H. Yeo in Teo & Rajathurai 1997
Sime Forest: Petaling Trail	12 Sep 2003	Night	In tree	R. Tan & N. Lim, photo
Upper Peirce Reservoir Park: access road from Old Upper Thomson Road	29 Oct 2004	Night	In tree	A. Yeo. Photo in Baker & Lim 2008
Nee Soon Swamp-forest: pipeline trail at bend of pipe	11 Nov 2010	Night (23h30)	N.A.	S. H. Yeo

(Continued)

Location	Date	Time	Habit when observed	Observer/Reference
Nee Soon Swamp-forest: pipeline trail at former pumphouse	21 Dec 2010	Night (21h15)	In tree near a stream	N. Baker & company, photo
Nee Soon Swamp-forest: pipeline trail, where pipe goes underground near pond	3 Apr 2011	Night (22h35)	In tree, made a 'chiirrp-chiirrp' call	C. Low & company, photo (Fig. 2)
Nee Soon Swamp-forest: pipeline trail	10 Apr 2011	Night (21h16)	In fruiting trees near a drain	M. Chua
<b><i>Paguma larvata</i></b>				
Pulau Tekong	1990	N.A.	N.A.	Teo & Rajathurai 1997, Lim <i>et al.</i> 2008
Central Catchment Nature Reserve: MacRitchie sector, Sime Road, Kalang Circus	13 Aug 1994	Night (22h15)	N.A.	Teo & Rajathurai 1997, Subaraj, Lim & Teo 2000, Lim <i>et al.</i> 2008
<b><i>Paradoxurus hermaphroditus</i></b>				
Tanglin: Singapore Botanic Gardens	1924	Dusk	Sometimes observed crossing grass lawns from tree to tree	Chasen 1924
Pasir Panjang: Zehnder Road	Sep 1985; 12 Apr 1987; 30 May 1987; Feb 1988	N.A.	Three juveniles accompanied by two adults; three young with two adults; two dashed through trees and then onto ground, growling and chasing each other; one confronted a cat in the house	Hall 1989
Upper Jurong: Pasir Laba Road	30 May 1986	N.A.	Trapped in the bathroom of an army barrack	Anon. 1988b, Lim 1996
Bukit Timah: Swiss Club Road	19 Oct 1986	Night (04h00)	N.A.	Anon.1988b
Pulau Ubin	20 Mar 1988	N.A.	In captivity; apparently taken on the island	Anon.1988a
Alexandra Park	29 Oct 1989	Night (02h00)	On a fence	Yeo 1989
Pulau Ubin: Sungei Maman mangroves	21 Feb 1992	N.A.	Possible individual	F. Hamid in Yeo & Lim 1992 as "civet cat"
Pulau Ubin	Between Apr and Nov 1993	N.A.	Uncommon resident based on surveys	Subaraj 2000
Pulau Ubin: Kampung Melayu	8 Apr 1993	N.A.	At edge of secondary forest	R. Subaraj in Anon. 1993
Central Catchment Nature Reserve	Between Jun 1993 and Jul 1997; 8 Jan 1995; 11 Mar 1995	N.A.; 09h30; morning & night	Five records within remnant agricultural habitat along fringes of forest, one in Lower Peirce sector, one in Mandai sector, and three in Upper Seletar sector; Upper Seletar sector: Mandai Range; Upper Seletar sector: Mandai Range forest – one juvenile in morning, one adult in night	Teo & Rajathurai 1997, Lim <i>et al.</i> 2000
Bedok: Lucky Heights, off Upper East Coast Road	Oct 1994, 21 May 1995 and 29 May 1995	N.A.	Three individuals trapped in roof space of one house	<i>The Straits Times</i> 2 Jun 1995, photos; Lim <i>et al.</i> 2000
Sentosa Island: Mount Serapong	Unknown, probably 1995	Night	Two records of at base of Mount Serapong, species identification unconfirmed	Subaraj 1995
Pulau Ubin: valley between Surau and Bukit Belukar	23 Jan 1999	N.A.	Seen from observation hide	B. Wee & company
Pulau Ubin: off Jalan Jelutong opposite Pekan Quarry	20 Mar 1999	Night (20h45)	Seen in bamboo clump	Members of VSG
Pulau Ubin: near junction of Jalan Batu Ubin and Jalan Noordin	20 Mar 1999	Night (21h35)	One adult with two cubs seen in papaya tree	Members of VSG
Pulau Ubin: off Jalan Noordin near National Police Cadet Corps campsite	23 May 1999	Night (01h00)	In coconut palm	Members of VSG
Pulau Ubin: Jelutong Bridge	19 Aug 2000	Night (21h30)	N.A.	R. Teo & company
Pulau Ubin: near Murai Hut	19 Aug 2000	Night (23h15)	Feeding on figs of <i>Ficus aurantiacea</i> in a rubber tree	R. Teo & company
Pulau Ubin: Jalan Endut Senin, near base of Puaka Hill	28 Oct 2000	Night (23h00)	N.A.	R. Teo & company



Location	Date	Time	Habit when observed	Observer/Reference
Tanglin: Cluny Road, Singapore Botanic Gardens, road near underground car-park of National Parks Board headquarters building	4 Feb 2001	Night (19h50)	Spotted at roadside from car	M. Strange & B. C. Ng
Upper Changi: Tanah Merah Besar Lane	23 Dec 2001	Night	N.A.	D. Yeo
Portsdown Road area: Jalan Hang Jebat	Dec 2002	Night	In mango tree	N. Baker
Bukit Timah Nature Reserve: Cave Path	2 Oct 2003	N.A.	In tree	N. Lim & H. H. Tan
Sungei Buloh Wetland Reserve: behind Visitor Centre	12 Apr 2003	Night (21h45)	In clump of fishtail palm <i>Caryota mitis</i> at the end of mangrove boardwalk	R. Subaraj & company
Upper East Coast Road: Kew Drive	1 Jul 2004	Night (23h00)	In suburban garden on a Yellow Cane Palm <i>Dypsis lutescens</i>	V. D'Rozario
Bukit Batok Nature Park	15 Oct 2004	Night	Two on the ground and then climbing up trees	K. W. Chan & N. Lim
Bukit Timah Nature Reserve	26 Jul 2004	Night	N.A.	A. Yeo, photo
Changi Point: Changi Beach Club	13 Apr 2005	Evening	Walking along the top of a tennis court fence	D. Yeo
Upper East Coast Road: Kew Drive	27 May 2005; 20 Jun 2005; 14 Aug 2005; 28 Aug 2005; 3 Sep 2005; 16 Dec 2005	07h00; 08h00; night; 20h00; 20h00; 20h40	Juvenile on roof of house; very wet baby climbed down Yellow Cane Palm; juvenile on mango tree; two juveniles in juniper tree <i>Juniperus</i> ; juvenile observed eating leaf buds of a tree with large leaves; a female with three kittens on mango tree	V. D'Rozario
Upper Jurong: forest patch next to Singapore Discovery Centre	24 Feb 2006	Evening	High up in tree	R. Teo & company
Pan Island Expressway: on the road shoulder heading toward BKE between lamp-posts 1226 and 1228	7 Jun 2006	Morning (08h30)	Large (2.75 kg) and almost intact carcass. Pelage was yellowish brown and the carcass had a strong pandan smell	Aminurashid bin Ekan
Mandai Road: just before junction of Mandai Lake Road at lamp-post 143	2 Sep 2006	Morning	Badly crushed road-kill	N. Abdullah
MacRitchie forest: MacRitchie Nature Trail, along boardwalk	7 Mar 2007	Night	Female	N. Lim & K.W. Chan, photo
Bukit Timah Road: near Newton Flyover	22 Mar 2007	Morning (08h30)	Road-kill	'Cynthia' (public record contribution)
Holland Road: next to forested patch opposite Maris Stella Kindergarten	19 May 2007	Evening (17h50)	Fresh road-kill	K. C. Chuang, photo
Bukit Timah: Rebecca Road	11 Jul 2007	Night (20h20)	One adult with five young observed climbing down a banyan tree in residential area	T. Schroter
Pulau Ubin: main jetty, near information kiosk	28 Oct 2007	Dusk	N.A.	R. Tan & company
Chestnut Forest	8 Nov 2007	Evening	One, perhaps two, seen resting high up in trees	N. Baker
Jalan Kembangan	28 Nov 2007	N.A.	Caught in a garden, in a cat trap	R. Ng
Upper East Coast Road: Kew Drive	20 Jan 2008	Night (20h15)	Two medium-sized individuals observed in a suburban garden	V. D'Rozario
Ulu Pandan: Holland Road, at about 20 m from junction of Tan Boon Chong Avenue, towards Holland Village	6 Feb 2008	Early morning	Female road-kill	H. T. W. Tan & S. S. N. Tan. Specimen (ZRC 4.8182) deposited at Raffles Museum [see text]
Tanglin: Nassim Road: on grass verge opposite the Philippine Embassy	16 Apr 2008	N.A.	Adult female road-kill	D. Boxall
Siglap: Frankel Avenue	Sep 2008	N.A.	"One group" reported residing "on top" of a house	W. Chan
Bedok: Taman Bedok	3 Sep 2008	Dawn (06h30)	Sighted in the backyard of a house	H. C. Chin
Sungei Buloh Wetland Reserve: behind the visitor centre	5 Sep 2008	Evening	N.A.	C. Goh & company, photo
Sungei Buloh Wetland Reserve: behind the visitor centre	3 Oct 2008	Evening	At least one sighted in a clump of bamboo	S. H. Chan & company

(Continued)

Location	Date	Time	Habit when observed	Observer/Reference
Pulau Ubin: compound of Outward Bound School	17 Dec 2008	Night (21h00)	Adult and one young	M. Chua & company
Pulau Ubin	12 Feb 2009	Night (01h30)	N.A.	R. Teo, photo
Pulau Ubin	17 Feb 2009	Night	N.A.	M. Chua & V. D'Rozario
Mandai Road: 300 m towards Upper Thomson Road after junction with access road to Mandai Columbarium	23 Mar 2009	Morning (08h00)	Road-kill	R. Lim
Bukit Timah Nature Reserve: main road to summit before Keruing Hut	26 Mar 2009	Night (21h00)	On right side of road, then bounded off down slope to the side	T. M. Leong & company
Nee Soon Swamp-forest: pipeline trail	7 May 2009	Night (19h30 & 20h30)	First one in forest off pipeline and second one before pipeline trail	M. Chua & company
Tanglin area: Ridley Park	17 May 2009	Night (21h00)	In suburban garden	F. Thomas
Bukit Timah Nature Reserve: Lasia Valley, Senapang Road	15 Aug 2009	Night	In tree	S. H. Yeo & V. D'Rozario, photo
Portsdown Road: near gate of Tanglin School	25 Aug 2009	N.A.	Dead example on roadside	J. Bromley
Bartley: Bidadari	28 Aug 2009	Night	One in tree in wooded former cemetery	M. Chua
Bukit Timah Nature Reserve: Catchment Path	26 Sep 2009	Night	In tree	K. W. Chan, photo
Bukit Timah Nature Reserve: Jungle Fall Path, about 30 m from main road	7 Nov 2009	Night	In tree	S. H. Yeo & B. C. Ng
Changi Point: Changi Village, tree area behind Apartment Block 5 and next to Apartment Block 21	10 Oct 2009	Night (01h30)	One on grass lawn observed climbing up a tree to join another	W. Remahl
Bukit Timah Nature Reserve	6 Mar 2010	Night	One in tree in strip of vegetation along the Bukit Timah Expressway opposite Catchment Pond; another at Jungle Fall Path	K. W. Chan & M. Chua, photos
Labrador Park	29 Mar 2010	Night (21h00)	On ground along a path in the forest patch, apparently feeding on emerging cicadas	T. M. Leong & Amin
Bukit Batok Nature Park	11 Jun 2010	Night (19h45)	One adult with three young	S. H. Yeo
Tanglin: Cluny Road, in front of Eusoff College	29 Sep 2010	Night (22h35)	Observed crossing road	D. Yeo
Upper East Coast Road: Kew Drive	15 Jan 2011	Night (22h20)	In a suburban garden	V. D'Rozario, photo
Bedok: Eastwood Drive	7 Jun 2011	Day	On a wooden beam under the attap roof (thatched with nipah palm) of a suburban house verandah, appeared unafraid of humans, and was on the beam all afternoon, disappearing in the early evening	K. French, photo
Western Catchment: Murai	8 May 2012	Night	One in tree near Murai Reservoir	M. Chua & company
<b><i>Viverra tangalunga</i></b>				
Mandai Track 16	Before 1969	N.A.	Reported to be common in this rural area, but species identification uncertain	Anon.1988b
Central Catchment Nature Reserve: Upper Seletar sector	Early 1990s	N.A.	Unconfirmed record. May be <i>V. zibetha</i>	Vasanthan in Teo & Rajathurai 1997
Pulau Tekong	Feb 1991	N.A.	Observed regularly foraging near Camp, but species identification uncertain. May be <i>V. zibetha</i>	K. W. Li in Yeo 1991
Central Catchment Nature Reserve: MacRitchie Reservoir forest	4–10 Jan 2012	Night (during 23h52 – 05h56)	Camera-trapped consuming carrion bait. From the images, it appeared that only one individual was photographed	Lim & Ou Yang 2012 (Fig. 3)
<b><i>Viverra zibetha</i></b>				
Jalan Bahar	May 1990	N.A.	Trapped by a farmer	<i>Sin Min Daily News</i> 14 May 1990, Anon. 1990

The locations of these records, except that of the escaped Binturong, are marked on Fig. 1.