NATURE IN SINGAPORE 2016 **9**: 165–198
Date of Publication: 1 November 2016

Freshwater fishes, terrestrial herpetofauna and mammals of Pulau Tekong, Singapore

Kelvin K.P. Lim[1*], Marcus A. H. Chua[1] & Norman T-L. Lim[2]

[1]Lee Kong Chian Natural History Museum, National University of Singapore, Singapore 117377, Republic of Singapore; Email: nhmlimkp@nus.edu.sg (KKPL; *corresponding author), marcuschua@nus.edu.sg (MAHC)
[2]Natural Sciences and Science Education Academic Group, National Institute of Education, Nanyang Technological University, 1 Nanyang Walk, Singapore 637616, Republic of Singapore; Email: norman.lim@nie.edu.sg (NTLL)

Abstract. The diversity of terrestrial and freshwater, non-avian, vertebrate fauna of Pulau Tekong, an island used almost exclusively by the Singapore Armed Forces, was compiled. Eighteen species of freshwater fishes, 15 of amphibians, 45 species of terrestrial reptiles, and 31 species of terrestrial mammals were recorded. Singapore records of the lizards: *Ptychozoon kuhli*, *Luperosaurus browni*, *Cyrtodactylus pantiensis* and the bat: *Murina suilla* are known only from Pulau Tekong. The island also has populations of the frogs: *Limnonectes paramacrodon* and *Occidozyga sumatrana*; the snakes: *Lycodon subcinctus*, *Boiga jaspidea* and *Tropidolaemus wagleri*; the lizard: *Cnemaspis peninsularis*, the slow loris: *Nycticebus coucang*, and the bats: *Rhinolophus trifoliatus* and *Kerivoula hardwickii*. These species are locally rare, and otherwise known only from the mature forests of the Central Catchment and Bukit Timah Nature reserves on Singapore Island. Pulau Tekong also supports populations of the leopard cat: *Prionailurus bengalensis*, the Sunda slow loris: *Nycticebus coucang*, the Malayan porcupine: *Hystrix brachyura* and the Sunda pangolin: *Manis javanica*—small mammals that are regarded to be rare and endangered in Singapore.

Key words. Pulau Tekong, freshwater fishes, amphibians, reptiles, mammals, Singapore.

INTRODUCTION

Pulau Tekong (Fig. 1) is located at the eastern entrance of the Straits of Johor, opposite the mouth of the Johor River, some 2 km off the north-eastern corner of Singapore Island. With a present land area of about 23.5 square kilometers, and still expanding with land reclamation, it is the second largest island within Singapore's political boundaries (Natural Areas Survey Team, 2008). Pulau Tekong is made up of three main islands linked by land reclamation. The largest, Pulau Tekong Besar, was 6.4 km across and about 4.1 km north to south. Ongoing land reclamation that began since the 1970s has greatly expanded its southern coast, and linked the main island with Pulau Tekong Kecil and Pulau Sajahat on the western side (Anonymous, 1978). While the reclaimed areas are flat, Pulau Tekong Besar has a raised area where the Pulau Tekong Reservoir is nestled, about 50 m asl at the highest point. A brackish hot-spring is present near the northern shore.

The natural vegetation on the island before human settlement was lowland dipterocarp forest with mangrove forest along the coast and tidal sections of stream drainages (Yee et al., 2011). Much of the original forest had been cleared for crop cultivation, the major one being rubber (Wu, 1971). Pulau Tekong Besar and its surrounding islands once held a human population of about 5,000 distributed in at least 15 villages (Chen & Lee, 2012). The residents, mainly Chinese and Malay, were largely occupied with farming and fishing. However, all of its residents were relocated to Singapore Island by 1987 when the island was completely taken over by the Singapore Armed Forces, exclusively for military purposes (Chen & Lee, 2012). The villages have been demolished and the farms and plantations abandoned. Today these are mostly succeeded by secondary forest (Fig. 2). The vegetation of the reclaimed land is largely grass and pioneer vegetation (Fig. 3). Trees are dominated by coastal taxa such as *Terminalia*, *Casuarina* and *Baringtonia*.

Although Pulau Tekong has been settled by humans at least since the mid-19th century, surprisingly little was known of the non-avian vertebrate fauna inhabiting the island. There have been very scant references, and a few specimens were deposited at the Lee Kong Chian Natural History Museum of the National University of Singapore, but a complete inventory of the freshwater fishes, amphibians, terrestrial reptiles and land mammals on Pulau Tekong had never been published.

Documentation of the non-avian vertebrate fauna of Pulau Tekong apparently began in 1996 with a brief survey conducted by the National Parks Board (NParks) with the Vertebrate Study Group of the Nature Society (Singapore) (Subaraj, 1996; Teo & Rajathurai, 1997). It followed with several visits in 2001 and 2002 (Robert Teo, pers. comm.). A study on the Sunda pangolin (*Manis javanica*) by NTLL, then a graduate student of the National University of Singapore (NUS), was conducted on the island in 2005 and 2006 (Lim, 2006; Lim & Lim, 2006; Lim et al., 2006; Lim, 2007; Lim & Ng, 2007). The vertebrate fauna inhabiting the Pulau Tekong Reservoir and its environs was surveyed in

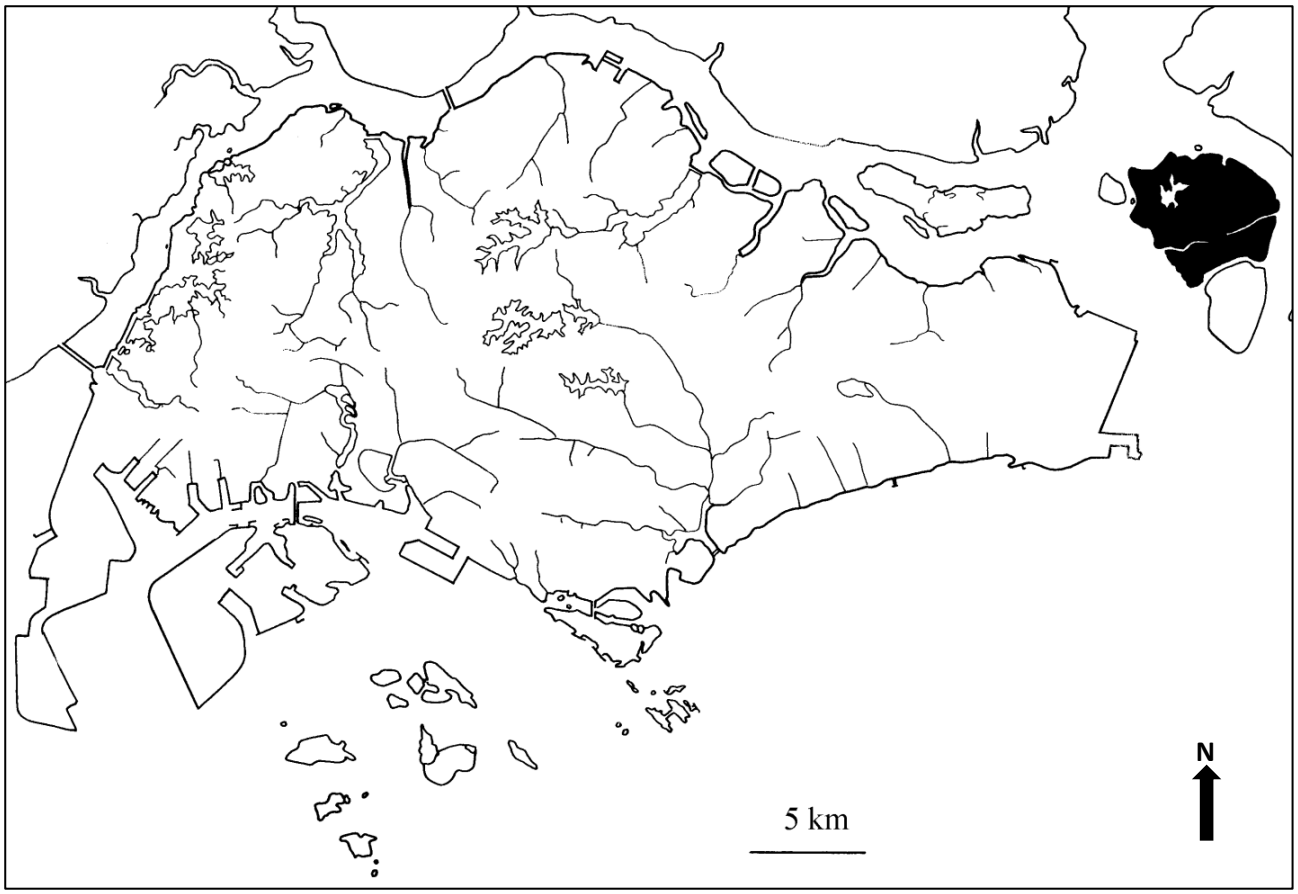
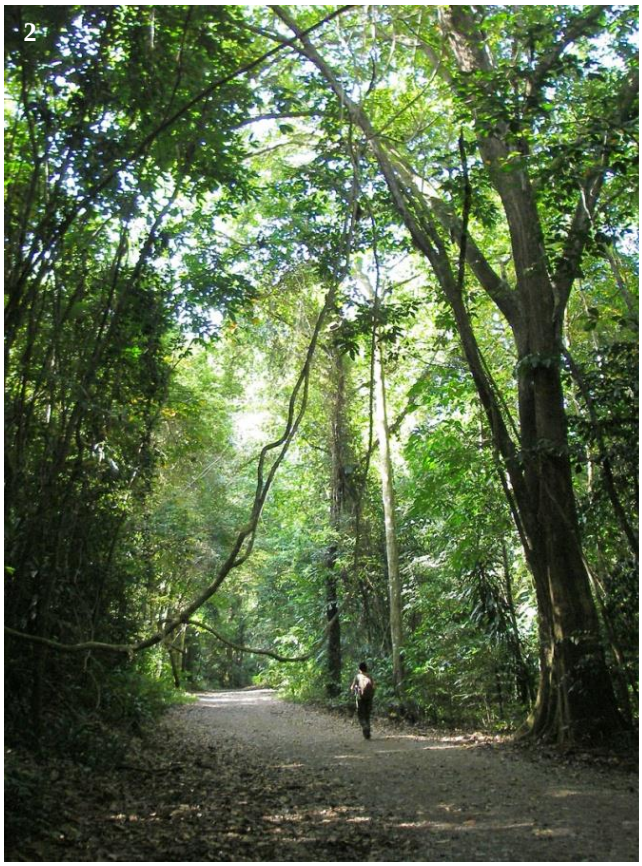
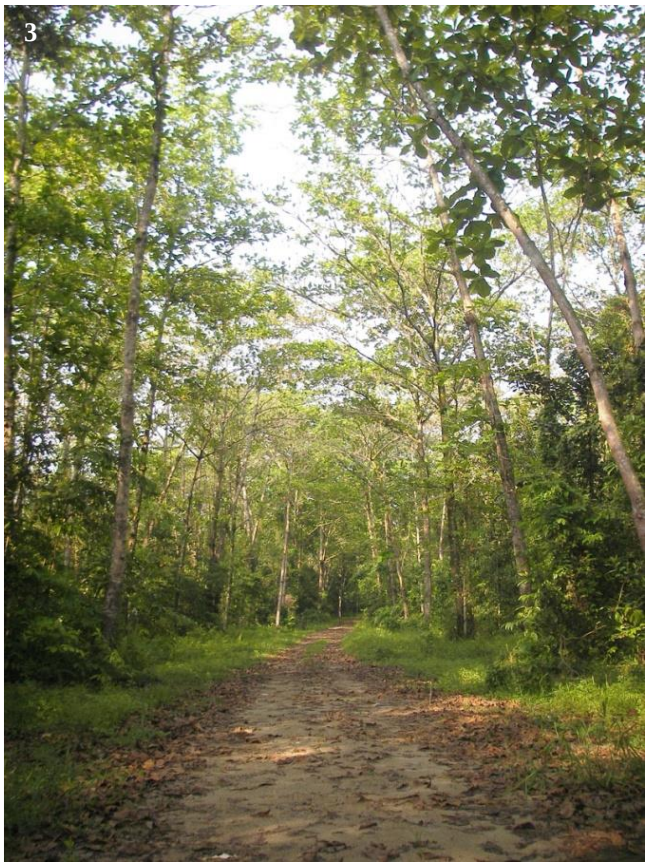


Fig. 1. Map of Singapore showing the location of Pulau Tekong (darkened area).





Figs. 2, 3. 2, Mature secondary forest at the north-western part of Pulau Tekong as on 31 December 2011. 3, Secondary vegetation on the reclaimed land at the southern part of Pulau Tekong as on 29 September 2012 (Photographs by: Kelvin K. P. Lim).

2007 and 2008 by a team from the NUS for the Public Utilities Board (Ng & Tan, 2010; Ng & Lim, 2010). In 2011 and 2012, NUS initiated a study on the leopard cats on the island by the second author (Chua et al., 2016). All the surveys have, in one way or another, contributed new discoveries and records of non-avian vertebrate fauna for Pulau Tekong, and Singapore. The present article is a compilation of information and records from various sources, combining all the terrestrial non-avian vertebrate diversity known from Pulau Tekong.

MATERIAL AND METHODS

The terrestrial non-avian vertebrate fauna of Pulau Tekong were recorded largely with in-situ observations and photography, both in the day, and at night by spotlighting. Areas were accessed by foot, bicycle or motor vehicle. Camera traps used in more recent surveys (2005–2006 and 2011–2012: 19 trap stations, 5,640 trap nights) captured images of the larger mammals, but occasionally photographed herpetofauna. Physical capture of specimens was largely avoided, but mist nets and a harp trap were used on occasions to obtain bats not easily photographed in flight, and whose roosts could not be located. The few specimens collected during the surveys were preserved and deposited in the Lee Kong Chian Natural History Museum (LKCNHM) at the National University of Singapore.

An annotated checklist of non-avian vertebrate fauna known from Pulau Tekong is herein presented. It includes freshwater fishes that live and complete their life cycles in inland water bodies above tidal influence, amphibians, reptiles (excluding marine representatives such as sea-snakes and sea turtles), and non-marine mammals. Names of taxa with confirmed occurrence (supported by photographic records and/or specimens at the Lee Kong Chian Natural History Museum of the NUS) are in bold print. Publications and unpublished reports that mention taxa from Pulau Tekong are cited. Nomenclature and classification largely follow Baker & Lim (2012) and Kottelat (2013). The following size measurements are cited: CL—carapace length (applies to turtles); FAL—forearm length (applies to bats), HBL—head and body length (applies to mammals), measured from tip of snout to base of tail; SL—standard length (applies to fish), measured from tip of upper jaw to base of caudal fin; SVL—snout-vent length (applies to frogs and lizards with incomplete tails), measured from snout tip to opening of vent; and TL—total length (applies to fish, snakes and lizards with complete tails), measured from snout tip to tip of tail or distal margin of caudal fin. Because Pulau Tekong is a protected military area, mention of place names and specific locations are generally avoided. Entry into Pulau Tekong to conduct the biodiversity surveys was under permission of the Singapore Ministry of Defence (MINDEF).

ANNOTATED CHECKLIST

Class Actinopterygi
ray-finned fishes

Order Cypriniformes

Family Cyprinidae

Barbodes banksi (Herre)
saddle barb

Reference. Ng & Lim, 1996: 110 (as *Puntius banksi*).
Remarks. The presence of this species on the island is not confirmed by recent surveys.

***Puntigrus tetrazona* (Bleeker)**
Sumatran tiger barb

Reference. Ng & Tan, 2010: 101 (Pulau Tekong Reservoir).
Remarks. The tiger barb was introduced to the Pulau Tekong Reservoir most likely as a living indicator of good water quality. It seems to be restricted to the reservoir for there has been no record from the out-flowing streams.

***Rasbora einthovenii* (Bleeker)**
Einthoven's rasbora (Fig. 4)

References. Ng & Lim, 1996: 112; Subaraj, 1996: 6; Baker & Lim, 2012: 34.
Remarks. This fish was first observed on the island in February 1996 by Subaraj (1996: 6). Surveys in late 2011 and 2012 confirm its occurrence in at least two streams in the north-central part of the island.

Order Siluriformes

Family Clariidae

***Clarias batrachus* (Linnaeus)**
common walking catfish (Fig. 5)

References. Subaraj, 1996: 12 (as 'common walking catfish'); Baker & Lim, 2012: 38.
Remarks. Known from the Pulau Tekong Reservoir, and observed in several streams on the island, this nocturnal species has also been found in mildly brackish water.

***Clarias gariepinus* (Burchell)**
African sharp-toothed walking catfish

Remarks. An introduced species from Africa, known on the island from one specimen collected in the Pulau Tekong Reservoir in 2007 (deposited at the Lee Kong Chian Natural History Museum of the NUS) but not recorded by Ng & Tan (2010). It is distinguished from the native common walking catfish (*Clarias batrachus*) in having a rectangular (versus oval) dorsal head shape, truncate (versus rounded) tail fin, and the underside of the head is white and sharply demarcated on the side of the head from the blackish upper surface (versus no such colour demarcation).

***Clarias nieuhofii* Valenciennes**
slender walking catfish (Fig. 6)

References. Baker & Lim, 2012: 39; Lim et al., 2008a: 149 (critically endangered in Singapore).
Remarks. Distinguished from the common walking catfish (*Clarias batrachus*) by its squarish (versus oval) dorsal head shape, wide gap (versus narrow gap) between the rear margin of the cranium and the origin of the dorsal fin, considerably longer body, and the tail fin being confluent with (versus completely separated from) the bases of the dorsal and anal fins. This native inhabitant of freshwater swamps is known only from two individuals photographed in the north-central part of the island in 2002.

Order Beloniformes

Family Zenarchopteridae

***Dermogenys collettei* Meisner**
Sunda pygmy halfbeak (Fig. 7)

Reference. Subaraj, 1996: 12 (as 'pygmy halfbeak').
Remarks. This small, surface-dwelling fish is common in freshwater and brackish water streams throughout the island, as well as along the edges of Pulau Tekong Reservoir. It frequently occurs alongside the whitespot (*Aplocheilus panchax*).

Order Cyprinodontiformes

Family Aplocheilidae

***Aplocheilus panchax* (Hamilton)**
whitespot (Fig. 8)

Reference. Ng & Lim, 1996: 112 (Tekong hotspring); Subaraj, 1996: 12 (observed in February 1996).
Remarks. The whitespot was found in the Pulau Tekong Reservoir, as well as in drainages all over the island in both fresh and brackish water. It also occurs in the hot spring at the northern part of the island (Ng & Lim, 1996; pers. obs. in 2011 and 2012).

Family Poeciliidae

Gambusia affinis (Baird & Girard)
western mosquitofish

Reference. Subaraj, 1996: 12 (as 'mosquito fish').
Remarks. The presence of this North American species on the island is not confirmed by recent surveys.

Figs. 4–8. 4, *Rasbora einthovenii* of about 4 cm TL, central, 20 January 2012; 5, *Clarias batrachus* of about 20 cm TL, central, 19 September 2006. 6, *Clarias nieuhofii* of about 30 cm TL, central, December 2002. 7, *Dermogenys collettei* of about 5 cm TL, central, 18 October 2011. 8, *Aplocheilus panchax* of about 4 cm TL, northeast, 11 August 2012. 9, *Xiphophorus helleri* of about 5 cm TL, northwest, 30 December 2011 (Photographs by: Marcus A. H. Chua [4], Norman T-L. Lim [5], Robert C. H. Teo [6], Kelvin K. P. Lim [7, 8], Vilma D'Rozario [9]).

***Xiphophorus helleri* Heckel**
swordtail (fig. 9)

Remarks. Up to 16 examples of this Central American livebearer have been observed in a well in the north-western part of the island in 2011 and 2012. They are of the red colour morph produced for the ornamental fish trade, and are believed to have been deliberately liberated to control mosquito breeding. The presence of small juveniles is indication that this alien has managed to breed in this small and isolated water body, but it is not known if the population is self sustaining in the long term.

Order Synbranchiformes

Family Synbranchidae

***Monopterus javanensis* Lacepède**
Sunda swamp-eel

Remarks. The only example of this air-breathing fish from the island was obtained in a puddle of water along a dirt track in the northern part of the island in February 2011.

Order Perciformes

Family Cichlidae

***Geophagus altifrons* (Heckel)**
long-finned eartheater

Reference. Ng & Tan, 2010: 109 (Pulau Tekong Reservoir).
Remarks. Although known from one example taken at the Pulau Tekong Reservoir, the existence of a localised population of this tropical South American native is highly possible. *Geophagus altifrons* and at least nine other species of cichlid fishes have been deliberately introduced in the reservoirs on Singapore Island where they have established thriving local populations (Ng & Tan, 2010).

***Oreochromis mossambicus* (Peters)**
Mozambique tilapia

Reference. Ng & Tan, 2010: 110 (Pulau Tekong Reservoir).
Remarks. Known only from the Pulau Tekong Reservoir where the species is believed to have been deliberately released. The Mozambique tilapia is native to east Africa, but has been introduced to numerous places throughout the world as a food fish.

Family Eleotrididae

***Oxyeleotris marmorata* (Bleeker)**
marbled gudgeon

Remarks. Large examples of over 20 cm have been taken from the Pulau Tekong Reservoir in 2007, but this commercially important food fish has not been encountered in the outflow streams. It is highly likely the species was introduced to the island.

Family Osphronemidae

***Betta pugnax* (Cantor)**
Malayan forest betta (Fig. 10)

Remarks. Curiously, the presence of this species on the island was confirmed only in March 2012. Robert Teo (pers. comm.) had noted similar fish inhabiting a stream at the south-eastern part of the original island in the 1980s, but could not confirm their identity. On Pulau Tekong, *Betta pugnax* is presently known only from a narrow (ca. 3 m wide) stream under forest canopy in the north-central part of the island, and found alongside these fishes: *Rasbora einthovenii*, *Aplocheilus panchax*, *Dermogenys collettei*, *Clarias batrachus* and *Channa striata*. Pulau Tekong is the smallest island thus far known to contain a native population of this mouth-brooding fish.

***Trichopodus trichopterus* (Pallas)**
three-spot gouramy

Remarks. Examples of this air-breathing fish have been collected in Pulau Tekong Reservoir. It has been observed in a stream with mildly brackish water (pers. obs., in 2012).

Figs. 10–15. 10, *Betta pugnax* of about 4 cm TL, central, 30 March 2012. 11, *Channa striata* of about 25 cm TL, central, 20 January 2012. 12, *Duttaphrynus melanostictus* of about 6 cm SVL, northwest, 30 December 2011. 13, *Ingerophrynus quadriporcatus* of about 4 cm SVL, northwest, 21 November 2006. 14, *Fejervarya cancrivorus* of about 8 cm SVL, northeast, 11 August 2012. 15, *Fejervarya limnocharis* of about 5 cm SVL, northeast, 9 June 2012. Photographs by: Marcus A. H. Chua [10, 11], Kelvin K. P Lim [12, 14, 15], Nick Baker [13].

Family Channidae

Channa gachua (Hamilton)
dwarf snakehead

Reference. Subaraj, 1996: 6 (first observed in February 1996).
Remarks. Despite the absence of confirmed records from recent surveys, the presence of this freshwater swamp dweller is possible due to the availability of suitable habitat and syntopic fishes such as *Clarias nieuhofii*, *Betta pugnax* and *Rasbora einthovenii*.

***Channa striata* (Bloch)**
paddyfield snakehead (Fig. 11)

Remarks. This large predatory fish has been obtained in the Pulau Tekong Reservoir, and observed throughout the island in small streams with freshwater or mildly brackish water.

Class Amphibia
amphibians

Order Anura

Family Bufonidae

***Duttaphrynus melanostictus* (Schneider)**
Asian toad (Fig. 12)

Remarks. The Asian toad has been observed throughout the island.

***Ingerophrynus quadriporcatus* (Boulenger)**
four-ridged toad (Fig. 13)

Reference. Baker & Lim, 2012: 54.
Remarks. This toad, typical of freshwater swamp forest, has been recorded from many parts of the island, and along the shores of the reservoir. Although seldom seen, its call may be heard both during the day and at night. Many individuals were observed calling and spawning at the edge of a pool in along a forest track at around 2230 hrs in November 2006 (pers. obs.).

Family Dicroglossidae

***Fejervarya cancrivorus* (Gravenhorst)**
crab-eating frog (Fig. 14)

Reference. Leong & Chou, 1999: 101 (tadpoles from hot spring, as *Rana cancrivora*).
Remarks. Ubiquitous on Pulau Tekong, particularly near the coast in the vicinity of brackish water, and also in the reclaimed land in the south. It has been recorded on almost all surveys conducted in 2011 and 2012. Among the frogs in the region, its larvae are exceptionally resilient to salinity and heat. They have been found in mangrove creeks, exposed puddles of water on dirt tracks, and even in the hot spring.

***Fejervarya limnocharis* (Gravenhorst)**
field frog (Fig. 15)

Reference. Subaraj, 1996: 12 (recorded in Feb.1996, as 'field frog').
Remarks. This species is also ubiquitous on the island, having been recorded on all surveys conducted in 2011 and 2012. It occurs together with the similar-looking crab-eating frog, but is largely found further inland, and apparently confined to freshwater. It is distinguished from the crab-eating frog by its more slender appearance and distinctly narrower head.

***Limnonectes paramacrodon* (Inger)**
masked swamp frog (Fig. 16)

Reference. Baker & Lim, 2012: 58; Lim & Leong, 2008: 157.
Remarks. Discovered on Pulau Tekong in 2002 from the central-eastern part (Robert Teo, pers. comm.), this nationally rare species is otherwise confined to a small area of the Central Catchment Nature Reserve on Singapore Island. Little is known of this apparently strict inhabitant of freshwater swamp forest, and its larval stages have yet to be recognised and described. Examples from Pulau Tekong differ from conspecifics on Singapore Island in being generally larger in size, being pale greyish-brown on the dorsum, and having distinctly less black markings on their tympanum. Recently it has also been found along streams in the northern part of the island. The species is regarded as nationally endangered (Lim & Leong, 2008).

***Occidozyga sumatranus* (Peters)**
yellow-bellied puddle frog (Fig. 17)

Reference. Baker & Lim, 2012: 59.
Remarks. First recorded from Pulau Tekong in 2002, this small, largely aquatic frog was obtained from swamp forest streams at the northern and eastern side of the island (Robert Teo, pers. comm.; pers. obs.).

Family Ranidae

***Chalcorana labialis* (Peters)**
copper-cheeked frog (Fig. 19)

Reference. Baker & Lim, 2012: 63 (as *Hylarana labialis*).
Remarks. This small, arboreal frog, typical of small forest streams, has been recorded from the northern and central parts of Pulau Tekong (pers. obs.). All examples seen were of the smaller, paler form.

Hylarana erythraea (Schlegel)
green paddy frog

Remarks. Known from only one example sighted along the shore of Pulau Tekong Reservoir in September 2007 (KLKP pers. obs.).

***Pulchrana baramica* (Boettger)**
golden-eared rough-sided frog (Fig. 18)

Reference. Baker & Lim, 2012: 62.
Remarks. This swamp-dwelling species was last photographed on Pulau Tekong along a dirt track in forest on the north-east in November 2011. Its distinctive call was also heard on the western side of the island (pers. obs.). Listed as nationally vulnerable to extinction (Lim & Leong, 2008).

Pulchrana laterimaculata (Barbour)
masked rough-sided frog

Reference. Baker & Lim, 2012: 62.
Remarks. The distinctive 'yip-yip-yip' cry of this swamp forest dweller has been heard (but not recorded) in 2005 at the south-western part of the island (KKPL, pers. obs.). In the absence of a sound recording and observation of a specimen, we regard the presence of this frog on Pulau Tekong as unconfirmed.

Family Rhacophoridae

***Polypedates leucomystax* (Gravenhorst)**
four-lined tree frog (Fig. 20)

Reference. Subaraj, 1996: 12 (observed in February 1996, as 'common treefrog').
Remarks. This arboreal species is ubiquitous on Pulau Tekong, and has been observed and heard on most surveys in 2011 and 2012.

Family Microhylidae

***Kaloula pulchra* Gray**
banded bull-frog (Fig. 21)

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'banded bullfrog').
Remarks. The banded bull-frog has been regularly recorded in built-up and forested areas from most parts of Pulau Tekong. It is believed to be an introduced species.

***Microhyla butleri* Boulenger**
painted chorus frog (Fig. 22)

Remarks. This species is widespread on Pulau Tekong, but is not frequently encountered (pers. obs.).

Figs. 16–21. 16, *Limnonectes paramacrodon* of about 7 cm SVL, northeast, 11 August 2012. 17, *Occidozyga sumatrana* of about 2 cm SVL, northeast, 29 September 2012. 18, *Pulchrana baramica* of about 6 cm SVL, northeast, 19 November 2011. 19, *Chalcorana labialis* of about 4 cm SVL, northeast, 29 September 2012. 20, *Polypedates leucomystax*, larger one about 6 cm SVL, northeast, 19 November 2011. 21, *Kaloula pulchra* of about 5 cm SVL, south, 17 November 2012 (Photographs by: Kelvin K. P. Lim).

***Microhyla fissipes* Boulenger**

East Asian ornate chorus frog (Fig. 23)

References. Lim et al., 2006: 101; Lim, 2006: 6–7; Baker & Lim, 2012: 65; Ng & Yeo, 2012: 96.

Remarks. First recorded in Singapore from Pulau Tekong in August 2005 (Lim, Yeo & Chan, 2006), this frog appears to be restricted to a small area in the north-western part of the island where it breeds in puddles of water along laterite tracks in secondary forest (pers. obs. in 2012). It shares these breeding sites with *Microhyla heymonsi*, *Microhyla butleri*, *Polypedates leucomystax* and *Fejervarya limnocharis*. This species has since been found on Singapore Island (Law, 2015: 30; Subaraj et al., 2016: 30).

***Microhyla heymonsi* Vogt**
dark-sided chorus frog (Fig. 24)

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'dark-sided chorus frog').
Remarks. This species is ubiquitous on Pulau Tekong, and has been recorded (usually heard) on most surveys in 2011 and 2012 (pers. obs.).

Figs. 22–27. 22, *Microhyla butleri* of about 2 cm SVL, northeast, 10 June 2012. 23, *Microhyla fissipes* of about 2 cm SVL, northwest, 9 June 2012. 24, *Microhyla heymonsi* of about 2 cm SVL, northeast, 11 August 2012. 25, *Trachemys scripta elegans* of about 20 cm CL, central, 30 March 2012. 26, *Cnemaspis peninsularis* of about 8 cm TL, central, 18 November 2005. 27, *Cyrtodactylus pantiensis* of about 10 cm TL, northeast, 17 November 2012 (Photographs by: Kelvin K. P. Lim [22–24], Vilma D'Rozario [25], Yeo Suay Hwee [26], Tan Siong Kiat [27]).

Class Reptilia
reptiles

Order Testudines

Family Geoemydidae

***Cuora amboinensis* (Daudin)**
Malayan box terrapin

Reference. Ng & Lim, 2010: 122 (Pulau Tekong Reservoir).
Remarks. Known on the island from only one adult individual obtained at the Pulau Tekong Reservoir in March 2007 (Ng & Lim, 2010).

Family Emydidae

***Trachemys scripta elegans* (Wied-Neuweid)**
red-eared slider (Fig. 25)

Reference. Ng & Lim, 2010: 124 (Pulau Tekong Reservoir).
Remarks. This alien species has been recorded from the Pulau Tekong Reservoir. In March 2012, one large adult was photographed in a stream at the central part of the island (pers. obs.). These individuals are most likely discarded pets.

Order Crocodylia

Family Crocodylidae

Crocodylus porosus Schneider
estuarine crocodile

References. Lim, 1991: 4 (Sungei Seminei in February 1991); Lim, 1994: 224; Ng et al., 1995: 124; Subaraj, 1996: 6 (sightings along northern coast); Baker & Lim, 2012: 121; Lim et al., 2008b: 173.
Remarks. Although there has been no recent sighting of crocodiles on Pulau Tekong, their presence is likely for the island's northern coast is still lined with mangrove vegetation. It is also possible that the reptiles are being kept away by the enormous amount of land reclamation works along the southern and western shores. Listed as nationally critically endangered (Lim et al., 2008b).

Order Squamata

Family Gekkonidae

***Cnemaspis peninsularis* Grismer et al., 2014**
Peninsular rock gecko (Fig. 26)

References. Subaraj, 1996: 6 (drain culvert near the reservoir in February 1996, as *Cnemaspis kendalli*); Teo & Rajathurai, 1997: 389 (drain culvert on Pulau Tekong Besar, as *Cnemaspis kendalli*); Baker & Lim, 2012: 78 (as *Cnemaspis kendallii*).
Remarks. Although recorded from Pulau Tekong since 1996, the presence of this forest dwelling lizard there is confirmed by a photograph of an apparently gravid individual taken in the central part of the island in November 2005 by Yeo Suay Hwee. There have been no subsequent records of this nationally threatened (vulnerable) lizard from the island (Lim et al., 2008 as *Cnemaspis kendallii*). Lizards previously identified as *Cnemaspis kendallii* from Singapore and the southern part of the Malay Peninsula and adjacent islands off the east coast are distinct from *Cnemaspis kendallii* from its type locality in Borneo, and have been reclassified as *Cnemaspis peninsularis* by Grismer et al. (2014).

***Cyrtodactylus pantiensis* Grismer, Chan, Grismer, Wood & Belabut**
Panti bent-toed gecko (Fig. 27)

Reference. Baker & Lim, 2012: 80 (part, as *Cyrtodactylus quadrivirgatus* non-Taylor).
Remarks. First recorded from the island as *Cyrtodactylus quadrivirgatus* in 2006 from a roadkill specimen, Tekong examples have subsequently been rediagnosed as *Cyrtodactylus pantiensis* by L. Lee Grismer. At least five examples of this swamp forest dweller have been recorded in 2011 and 2012 from the northern and central parts of the island. This is

a southward range extension of *Cyrtodactylus pantiensis* (Grismer, 2011: 414), as well as the first record of this species in Singapore.

***Gehyra mutilata* (Wiegmann)**
four-clawed gecko

Remarks. This common house gecko has been seen on buildings and tree trunks at various parts of the island in 2005 and 2012 (pers. obs.).

***Gekko monarchus* (Duméril & Bibron)**
spotted house gecko (Fig. 28)

References. Subaraj, 1996: 12 (recorded in February 1996, as 'spotted house gecko); Lim & Lim, 2006: 107 (Batu Koyok area in scrub vegetation).
Remarks. Common on Pulau Tekong where it can be found on tree trunks, among foliage of bushes, buildings, wells, and most notably in drain culverts among roosting false vampires (*Megaderma spasma*).

***Hemidactylus frenatus* Duméril & Bibron**
spiny-tailed house gecko (Fig. 29)

Reference. Lim & Lim, 2006: 107 (Batu Koyok area in scrub vegetation).
Remarks. This gecko is common throughout Pulau Tekong on building structures, tree trunks, and even on foliage of bushes. It is distinguished from other house-dwelling geckos by its tail, which is covered by short spines.

***Hemidactylus platyurus* (Schneider)**
flat-tailed gecko

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'flat-tailed gecko').
Remarks. This house gecko was observed on buildings during surveys in 2005 and 2011, but seems to be far less common than *Hemidactylus frenatus*. The related frilly gecko (*Hemidactylus craspedotus*) is mentioned by Baker & Lim (2012: 78) and Lim et al. (2008b: 172 as *Cosymbotes craspedotus*) as occurring on Pulau Tekong. However, this record is not supported by sightings or photographs, and should be treated as erroneous.

***Lepidodactylus lugubris* (Duméril & Bibron)**
mourning gecko (Fig. 30)

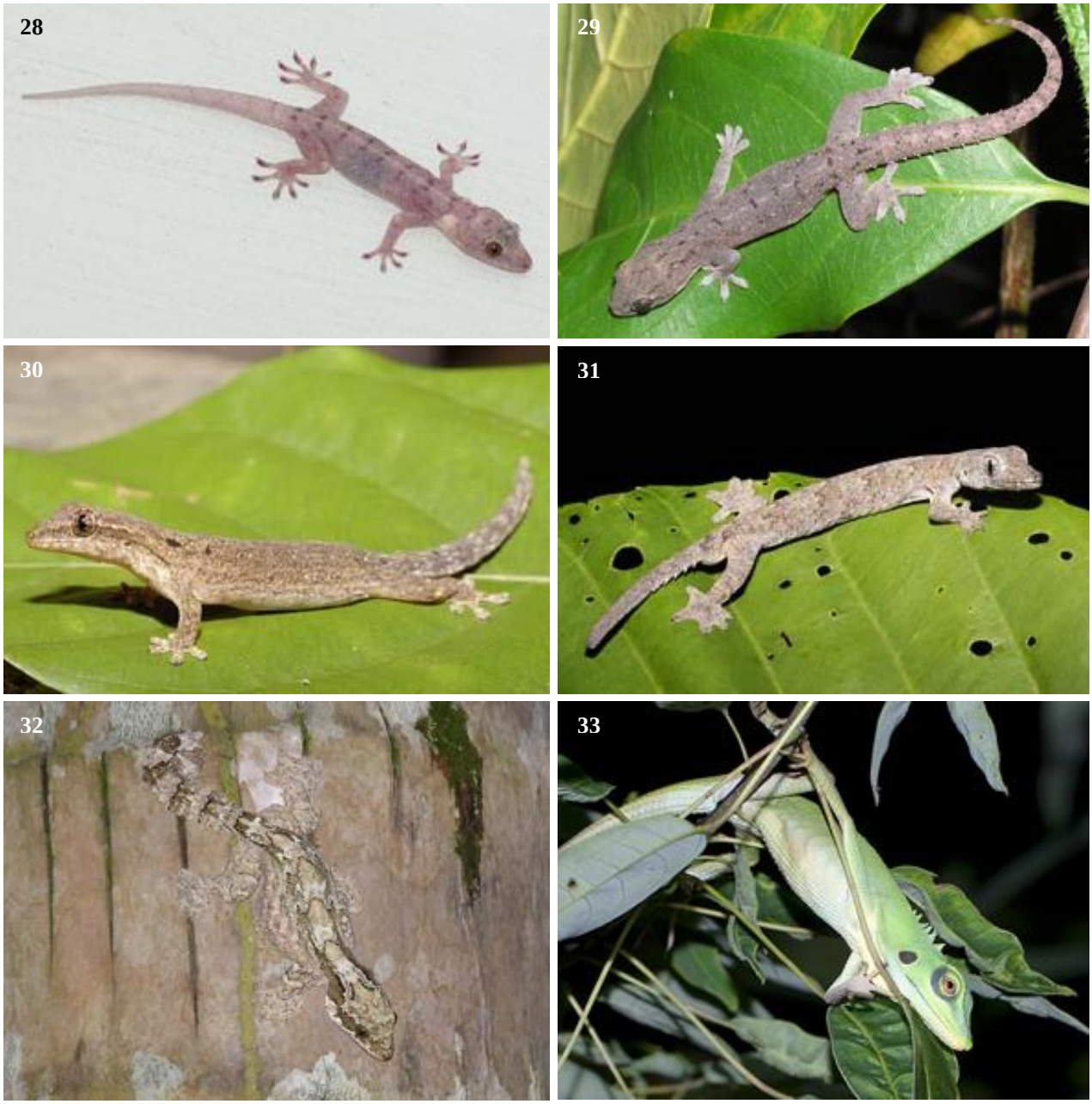
Remarks. This species is known from only one individual found on the eastern side of the island in August 2005.

***Luperosaurus browni* Russell**
Brown's flap-legged gecko (Fig. 31)

References. Lim & Lim, 2006: 107 (first Singapore record); Lim, 2006: 5; Baker & Lim, 2012: 83; Lim et al., 2008b: 172; Grismer, 2011: 517.
Remarks. This enigmatic and apparently rare gecko was first recorded for Singapore from the western side of Pulau Tekong in August 2005. It was also only the third known example of this species recorded for the entire Malay Peninsula (Grismer, 2011: 517). Subsequent surveys on the island have not been successful in finding additional specimens. Listed as critically endangered within Singapore (Lim et al., 2008b).

***Ptychozoon kuhli* Stejneger**
Kuhl's gliding gecko (Fig. 32)

References. Lim, 2006: 4 (first recorded in 2002); Baker & Lim, 2012: 83; Lim et al., 2008b: 171; Grismer, 2011: 530.
Remarks. This gliding gecko was recorded for Singapore in 2002 from Pulau Tekong. It is found in old secondary forests throughout the northern half and central parts of the island, but not on the reclaimed lands (pers. obs. in 2005, 2011 and 2012). This gecko appears to favour large trees and was recorded at an encounter rate of up to 2.71 individuals km^{-1} within an area of tall secondary forest on the island. Remarkably, it does not seem to be present on Singapore Island, or on neighbouring Pulau Ubin. Lim et al. (2008b) listed the species as nationally critically endangered.



Figs. 28–33. 28, *Gekko monarchus* of about 12 cm TL, northeast, 11 August 2012. 29, *Hemidactylus frenatus* of about 8 cm TL, northwest, 4 August 2005. 30, *Lepidodactylus lugubris* of about 6 cm TL, northeast, 6 August 2005. 31, *Luperosaurus browni* of 5.9 cm SVL, northwest, 4 August 2005. 32, *Ptychozoon kuhli* of about 14 cm TL, northeast, 3 August 2005. 33, *Bronchocela cristatella* of about 30 cm TL, north, 28 January 2012 (Photographs by: Vilma D'Rozario [28, 33], Kelvin K. P. Lim [29, 32], Norman T-L. Lim [30, 31]).

Family Agamidae

***Bronchocela cristatella* (Kuhl)**
green crested lizard (Fig. 33)

Reference. Subaraj, 1996: 12 (recorded in February 1996 as 'green crested lizard').
Remarks. This arboreal lizard has been observed regularly throughout Pulau Tekong, including the reclaimed areas, during surveys in 2005, 2011 and 2012 (pers. obs.).

***Calotes versicolor* (Daudin)**
changeable lizard (Fig. 34)

Remarks. An introduced species that probably came to the island with ornamental plants. First noted in 2011, it has been observed in the western and eastern sides of Pulau Tekong Besar, as well as on the reclaimed land in the south.

Draco sumatranus Schlegel
Sumatran flying dragon

Reference. Subaraj, 1996: 12 (recorded in Feb.1996 as 'common flying lizard').
Records. One example was observed on the western side of Pulau Tekong in October 2010 and one on the southern reclaimed land in July 2012 (MAHC, pers. obs.).

Family Scincidae

Emoia atrocostata (Lesson)
mangrove skink

Remarks. This coastal skink was sighted once during a survey in October 2001 (Robert Teo, pers. comm.).

***Eutropis multifasciata* (Kuhl)**
many-lined sun skink (Fig. 35)

Reference. Subaraj, 1996: 12 (as 'common sun skink').
Remarks. This lizard appears to be uncommon on Pulau Tekong. One was sighted on the north-western end of the island in August 2005. On the central part, one was photographed along a stream in January 2012, and a large individual was observed on a tree trunk in June 2012 (pers. obs.). This species was first recorded on the island in February 1996 by Subaraj (1996).

Lygosoma bowringi (Günther)
garden supple skink

Remarks. One individual was encountered on the south reclaimed land in December 2011 (MAHC, pers. obs.).

Family Varanidae

***Varanus nebulosus* (Gray)**
clouded monitor (Fig. 36)

References. Subaraj, 1996: 6 (record from February 1996 unconfirmed); Baker & Lim, 2012: 88.
Remarks. Rarely seen on Pulau Tekong. One juvenile was recorded on the north-eastern side of the island in March 2006 (pers. obs.). Another was observed up a tree at the western side in March 2012 and eastern side in October 2012 (pers. obs.).

***Varanus salvator* (Laurenti)**
Malayan water monitor (Fig. 37)

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'Malayan water monitor').
Remarks. Curiously uncommon on Pulau Tekong. Individuals have been photographed by camera traps in 2005 and 2011–2012.

Family Typhlopidae

***Ramphotyphlops braminus* (Daudin)**
brahminy blind snake (Fig. 38)

Remarks. Only one example of this common fossorial snake has been recorded on Pulau Tekong (pers. obs. in July 2011).

Family Xenopeltidae

***Xenopeltis unicolor* Reinwardt**
sunbeam snake (Fig. 39)

Reference. Baker & Lim, 2012: 92.
Remarks. This burrowing snake is known from two roadkills in 2005 and 2011, the latter on the southern reclaimed land (pers. obs.).

Figs. 34–39. 34, *Calotes versicolor* of about 25 cm TL, northeast, 18 November 2011. 35, *Eutropis multifasciata* of about 25 cm TL, central, 3 June 2012. 36, *Varanus nebulosus* of about 1 m TL, northeast, 28 October 2012. 37, *Varanus salvator* of about 2 m TL, central, 4 October 2005. 38, *Ramphotyphlops braminus* of about 8 cm TL, central, 16 July 2011. 39, *Xenopeltis unicolor*, roadkill of about 50 cm TL, central, 3 August 2005 (Photographs by: Francis L. K. Lim[34], Marcus A. H. Chua [35, 36], Norman T-L. Lim [37; camera trap photo], Celine H. S. Low [38], Kelvin K. P. Lim [39]).

Family Pythonidae

***Malayopython reticulatus* (Schneider)**
reticulated python (Fig. 40)

Reference. Subaraj, 1996: 12 (recorded in Feb.1996 as 'reticulated python').
Remarks. The python is probably the largest land predator on Pulau Tekong. It has been recorded on at least three occasions during surveys in 2006 (pers. obs.). A large example was photographed by camera trap in 2011 and another seen in a drain in 2012, both in the eastern part of the island (pers. obs.).

Family Colubridae

***Ahaetulla prasina* (Boie)**
Oriental whip snake (Fig. 41)

Remarks. This species appears to be relatively uncommon on Pulau Tekong. One was photographed in the western side in December 2004 (pers. obs.). Three examples were recorded from the central and northern areas in 2011 and 2012 (pers. obs.).

***Boiga cynodon* (Boie)**
dog-toothed cat snake (Fig. 42)

Reference. Baker & Lim, 2012: 94.
Remarks. There are two records of this nationally endangered forest-dwelling snake (Lim et al., 2008b) from Pulau Tekong. One from the north-eastern side in 2006, and the other from the north-western forest in 2011 (pers. obs.).

***Boiga dendrophila* (Boie)**
gold-ringed cat snake (Fig. 43)

Reference. Subaraj, 1996: 12 (recorded in Feb.1996, as 'mangrove snake').
Remarks. A single roadkill was photographed on the island in 2006 (fig. 43). Listed as nationally vulnerable to extinction (Lim et al., 2008b)

***Boiga jaspidea* (Duméril, Bibron & Duméril)**
jasper cat snake (Fig. 44)

References. Baker & Lim, 2012: 95; Lim et al., 2008b: 162.
Remarks. Two examples were recorded in 2005 and 2006, and a roadkill was found in 2011 (pers. obs.). In October 2012, an example was observed coiled on a leafy branch some two metres above a freshwater swamp. The coiled snake had looked deceptively like an ant nest (pers. obs.). This forest-dwelling species is regarded as critically endangered in Singapore (Lim et al., 2008b).

***Chrysopelea paradisi* Boie**
paradise gliding snake (Fig. 45)

Remarks. Although a common snake in urban and suburban areas on Singapore Island (Baker & Lim, 2012), this species appears to be uncommon on Pulau Tekong. Two examples were recorded in 2006, and only one was found in 2011 (pers. obs.).

***Coelognathus flavolineatus* (Schlegel)**
common Malayan racer (Fig. 46)

Remarks. This species was recorded from the north-central and north-eastern parts of Pulau Tekong on three instances in 2006 (pers. obs.). Lim et al. (2008b) listed this species as nationally endangered.

***Dendrelaphis caudolineatus* (Gray)**
striped bronzeback (Fig. 47)

Remarks. There were six records of this species from the northern half of Pulau Tekong in 2005, 2006, 2011 and 2012 (pers. obs.).

***Dendrelaphis pictus* (Gmelin)**
painted bronzeback (Fig. 48)

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'painted bronzeback').
Remarks. This arboreal snake is fairly common on Pulau Tekong and has been recorded throughout the island in 2005, 2006, 2011 and 2012 (pers. obs.).

Figs. 40–45. 40, *Malayopython reticulatus* of at least 2 m TL, northeast, 25 March 2006. 41, *Ahaetulla prasina* of about 1 m TL, central, 20 January 2012. 42, *Boiga cynodon*, roadkill of about 2 m TL, northeast, 19 April 2006. 43, *Boiga dendrophila* , roadkill of about 1 m TL, central, 30 September 2006. 44, *Boiga jaspidea* of about 1 m TL, northeast, 29 September 2012. 45, *Chrysopelea paradisi*, roadkill of about 60 cm TL, northwest, 27 September 2011 (Photographs by: Norman T-L. Lim [40, 43], Marcus A. H. Chua [41, 44], Chim Chee Kong [43], Kelvin K. P. Lim [45].

***Dryophiops rubescens* (Gray)**
keel-bellied whip snake (Fig. 49)

Reference. Baker & Lim, 2012: 102.
Remarks. There have been at least four records of this arboreal snake from Pulau Tekong: two in 2006 and two road kills in 2011 (pers. obs.). Listed as nationally critically endangered (Lim et al., 2008b).

Figs. 46–51. *Coelognathus flavolineatus*, roadkill of about 40 cm TL, central, 27 June 2006. 47, *Dendrelaphis caudolineatus* of about 50 cm TL, central, 12 September 2005. 48, *Dendrelaphis pictus* of about 90 cm TL, northwest, 16 September 2005. 49, *Dryophiops rubescens* of about 60 cm TL, central, 21 May 2006. 50, *Gonyosoma oxycephalum* of about 2 m TL, northwest, 17 August 2006. 51, *Lycodon capucinus* of about 30 cm TL, northwest, September 2006 (Photographs by: Norman T-L. Lim [46, 47 (camera trap photo), 49–51], Chan Kwok Wai [48]).

***Gonyosoma oxycephalum* (Boie)**
red-tailed racer (Fig. 50)

Reference. *Gonyosoma oxycephalum* – Baker & Lim, 2012: 103 (image of example photographed at Pulau Tekong).
Remarks. This strongly arboreal snake that is associated with mature lowland forest is nationally endangered (Lim et al., 2008b). While it is typically green in colour, the only example recorded on Pulau Tekong is an orange morph. It was photographed on the western side of the island in Singapore Island in August 2006.

***Lycodon capucinus* Boie**
house wolf snake (Fig. 51)

Remarks. This species is commensal with humans. It has been recorded throughout Pulau Tekong on a few occasions in 2005 and 2006, and in 2011 and 2012 (pers. obs.).

***Lycodon subcinctus* Boie**
banded wolf snake (Fig. 52)

References. Baker & Lim, 2012: 104 (image of example from Pulau Tekong); Lim et al., 2008b: 164.
Remarks. This seems to be a rare forest dwelling species in Singapore with only three recent records. One of them, a large adult whose whitish bands had darkened considerably, was encountered on the north-eastern side of Pulau Tekong in November 2006. Listed as nationally critically endangered (Lim et al., 2008b).

***Oligodon octolineatus* (Schneider)**
striped kukri snake (Fig. 53)

Reference. Baker & Lim, 2012: 106.
Remarks. There have been at least six records of this snake from the northern half of Pulau Tekong between 2003 and 2012 (Jean Yong, pers. comm.; pers. obs.).

***Pseudorabdion longiceps* (Cantor)**
dwarf reed snake (Fig. 54)

Reference. Baker & Lim, 2012: 106 (image of example from Pulau Tekong).
Remarks. Two examples of this species were photographed in the central part of Pulau Tekong in September 2006 and October 2011, respectively (pers. obs.). Listed as nationally endangered (Lim et al., 2008b).

***Sibynophis melanocephalus* (Gray)**
black-headed collared snake (Fig. 55)

Reference. Baker & Lim, 2012: 108.
Remarks. This nationally endangered snake (Lim et al., 2008b) was recorded only once on Pulau Tekong. A roadkill was photographed on the western side, in October 2005 (Fig. 55).

Family Homalopsidae

***Cerberus schneiderii* (Schlegel)**
dog-faced water snake (Fig. 56)

Remarks. Only one example has been recorded from Pulau Tekong. It was photographed in July 2012 at the edge of the mangrove-lined channel that separates Pulau Tekong Besar from the southern reclaimed land (Fig. 56).

***Homalopsis buccata* (Linnaeus)**
puff-faced water snake

Remarks. Known from three large specimens taken from the Pulau Tekong Reservoir in March 2007 and preserved in the LKCNHM.

Family Elapidae

***Bungarus fasciatus* (Schneider)**
banded krait (Fig. 57)

Reference. Baker & Lim, 2012: 115; Lim et al., 2008b: 166 (endangered in Singapore; image of example from Pulau Tekong).
Remarks. The presence of this species on Pulau Tekong is confirmed by an example photographed on the north-western side of the island by a mangrove-lined creek in May 2006 (NTLL, pers. obs.).

Figs. 52–57. *Lycodon subcinctus* of about 60 cm TL, northeast, 7 November2006. 53, *Oligodon octolineatus* of about 40 cm TL, central, 16 December 2005. 54, *Pseudorabdion longiceps* of about 15 cm TL, central, 15 September 2006. 55, *Sibynophis melanocephalus* of about 30 cm TL, northwest, 19 October 2005. 56, *Cerberus schneiderii* of about 40 cm TL, south, 7 July 2012. 57, *Bungarus fasciatus* of about 1 m TL, northwest, 22 May 2006 (Photograph by: Norman T-L. Lim [52, 53, 55, 57], Kelvin K. P. Lim [54], Marcus A. H. Chua [56]).

***Calliophis intestinalis* (Laurenti)**
banded Malayan coral snake

Remarks. There are four records from Pulau Tekong between 2004 and 2011 (R. Subaraj, Andrew Tay, pers. comm.; pers. obs.). Lim et al. (2008b) listed this species as nationally vulnerable.

***Ophiophagus hannah* (Cantor)**
king cobra (Fig. 58)

References. Lim, 1994: 219; Teo & Rajathurai, 1997: 385 (juvenile recorded in mid-1980's); Baker & Lim, 2012: 118; Lim et al., 2008b: 167 (endangered in Singapore); Lim et al., 2011: 144–146.
Remarks. Three juvenile examples were recorded from Pulau Tekong (Lim et al., 2011).

***Naja sumatrana* Müller**
equatorial spitting cobra (Fig. 59)

Reference. Subaraj, 1996: 12 (recorded in February 1996, as 'common cobra').
Remarks. This venomous snake was seen on many occasions on the island in 2005 and 2006 (NTLL, pers. obs.). It was, however, recorded only once in 2012. One example was observed in June at the central part of the island (pers. obs.).

Family Viperidae

***Cryptelytrops purpureomaculatus* (Gray)**
shore pit-viper

Remarks. The material cited is a roadkill found on the western side of the island in January 2012 (pers. obs.). It constitutes the first record of this arboreal and nationally endangered species (Lim et al., 2008b), which is associated with coastal vegetation, on Pulau Tekong.

***Tropidolaemus wagleri* Wagler**
Wagler's pit-viper

References. Sworder, 1924: 20 (as *Trimeresurus wagleri*); Teo & Rajathurai, 1997: 386; Baker & Lim, 2012: 120.
Remarks. This appears to be the first and only species of herpetofauna recorded from Pulau Tekong in the distant past (Sworder, 1924). In 1985, a large female was obtained at the central part of the island and preserved at the LKCNHM. The Wagler's pit-viper inhabits mature lowland forest and swamp forest. Its presence on the island indicates that not all of the original vegetation had been cleared for cultivation. However, it was not recorded on recent surveys. Listed as nationally endangered (Lim et al., 2008b).

Class Mammalia
mammals

Order Pholidota

Family Manidae

***Manis javanica* Desmarest**
Sunda pangolin (Fig. 60)

References. Lim et al., 1996: 1 (one at Botak Hill in May–June 1994); Subaraj, 1996: 5 (two records by army personnel); Lim, 2006: 6–7; Lim & Ng, 2007: 111; Baker & Lim, 2012: 150; Lim et al, 2008c: 191.

Remarks. Despite being labeled as internationally endangered and critically endangered in Singapore (Duckworth et al., 2008; Lim et al., 2008c), the Sunda pangolin has been observed on a fairly regular basis across terrestrial habitats on the island in 2005 and 2006, where a survey of the home ranges of this animal was conducted using radio telemetry and infrared camera traps (Lim & Ng, 2007). Sunda pangolins were also recorded across Pulau Tekong in 2011 and 2012 during visual surveys and by camera traps (pers. obs.).

Order Primates

Family Lorisidae

***Nycticebus coucang* (Boddaert)**
Sunda slow loris (Fig. 61)

References. Anonymous, 1990: 4 (one caught by villagers in north between 1987 and 1988); Lim et al., 1996: 1 (one at Camp I in May-June 1994); Sivasothi, 1996: 27 (one caught by villagers in north between 1987 and 1988); Subaraj, 1996: 5 (two sightings by army personnel); Lim, 2006: 6; Baker & Lim, 2012: 134; Lim et al., 2008c: 198 (critically endangered in Singapore); Teo & Rajathurai, 1997: 368 (sight records in 1993 and 1995, as *Nycticebus coucang coucang*).
Remarks. The Sunda slow loris has been known from Pulau Tekong since 1930 based on a skin deposited at the Lee Kong Chian Natural History Musem (NUS). Even though it is regarded as internationally vulnerable and critically endangered in Singapore (Lim et al., 2008c; Nekaris & Streicher, 2008), this animal was regularly observed throughout Pulau Tekong (except for the southern reclaimed land) in old secondary forest in 2005 and 2006, and subsequently in

2011 and 2012 (pers. obs.). Encounter rate of the Sunda slow loris in secondary forest on the original island was 0.621 individuals km^{-1} in 2011 and 2012 (n=23).

Fig. 58–63. 58, *Ophiophagus hannah*, roadkill of about 30 cm TL, central, 27 June 2006. 59, *Naja sumatrana* of about 1 m TL, northwest, 30 September 2006. 60, *Manis javanica* of about 60 cm HBL, central, 24 June 2005. 61, *Nycticebus coucang* of about 20 cm HBL, northwest, 6 October 2011. 62, *Macaca fascicularis*, larger of about 40 cm HBL, northwest, 30 March 2012. 63, *Cynopterus brachyotis* of about 10 cm HBL, central, 7 August 2005 (Photographs by: Norman T-L. Lim [58, 57, 63], Alan W. M. Yeo [60], Marcus A. H. Chua [61], Vilma D'Rozario [62])

Family Cercopithecidae

***Macaca fascicularis* (Raffles)**
long-tailed macaque (Fig. 62)

References. Sivasothi, 1996: 27 (one troop near 100 m range in June 1991, as 'long-tailed macaque'); Subaraj, 1996: 11 (as 'long-tailed macaque'); Baker & Lim, 2012: 134.
Remarks. This monkey has been regularly observed on Pulau Tekong during surveys conducted in 2005 and 2006, and in 2011 and 2012 (pers. obs.). At least two troops are present—one on the eastern and the other on the western part of the island. On one occasion in March 2012, about 30 individuals were counted in a troop on the western part of the island (pers. obs.).

Order Chiroptera

Family Pteropodidae

***Cynopterus brachyotis* (Müller)**
lesser short-nosed fruit bat (Fig. 63)

References. Subaraj, 1996: 11 (as 'short-nosed fruit bat'); Lim et al., 2008c: 193 (first discovered on Pulau Tekong in January 2002, as *Cynopterus sphinx*).
Remarks. A common bat on Pulau Tekong. Some individuals on the island appeared larger and had been identified as *Cynopterus sphinx* (Vahl), the greater short-nosed fruit bat. We follow Francis (2008) in not recognising the occurrence of *Cynopterus sphinx* in the southern part of Peninsular Malaysia (and Singapore).

Pteropus vampyrus (Linnaeus)
Malayan flying fox

Reference. Ng et al., 1995: 150 (as *Pteropus vampyrus malaccensis*).
Remarks. There are no confirmed records of this large bat from Pulau Tekong. It is, however, entirely possible for individuals roosting over in Johor to the north, or the Riau Islands to the south, to visit the island when fruits are in season.

***Macroglossus minimus* Geoffroy**
long-tongued nectar bat

Reference. Lim et al., 2008: 193 (vulnerable in Singapore; image of example from Pulau Tekong).
Remarks. One example of this small bat was caught with mist-nets in 2001 (Robert Teo, pers. comm.).

Family Emballonuridae

***Saccolaimus saccolaimus* (Temminck)**
pouched tomb bat (Fig. 64)

Remarks. Several examples had been observed roosting in buildings at the eastern side of Pulau Tekong in 2005, 2006 and 2011 (pers. obs.).

Family Megadermatidae

***Megaderma spasma* (Linnaeus)**
Malayan false vampire (Fig. 65)

References. Subaraj, 1996: 5 (four in a drain culvert near reservoir in February 1996); Baker & Lim, 2012: 147 (image from Pulau Tekong); Lim et al., 2008c: 195.
Remarks. The false vampire presently exists in Singapore only on Pulau Ubin and Pulau Tekong. Although classified as critically endangered in Singapore (Lim et al., 2008c), appears to have established on parts of Pulau Tekong, and has been found roosting in abandoned buildings, wells and drain culverts. One roost in a drain culvert on the western part of the island had about 16 individuals (pers. obs. in September 2011). Breeding females with young have also been observed (pers. obs.).

Fig. 64–69. 64, *Saccolaimus saccolaimus* of about 7 cm FAL, northeast, November 2006. 65, *Megaderma spasma* of about 6 cm FAL, northwest, 28 January 2012. 66, *Rhinolophus trifoliatus* of about 5 cm FAL, northwest, 24 June 2005. 67, *Kerivoula hardwickii* of about 3.4 cm FAL, with pup, central, 27 October 2012. 68, *Murina suilla* of about 2.9 cm FAL, central, 27 October 2012. 69, *Myotis* cf. *adversus* of about 4 cm FAL, northwest, 28 April 2012 (Photographs by: Nick Baker [64], Marcus A. H. Chua [65, 67–69], Alan W. M. Yeo [66])

Family Rhinolophidae

***Rhinolophus trifoliatus* Temminck**
trefoil horseshoe bat (Fig. 66)

References. Baker & Lim, 2012: 146; Lim et al., 2008c: 196 (critically endangered in Singapore).
Remarks. This microbat is apparently associated with swamp forest habitat. Apart from the one example obtained in the eastern part of the island in 2002 (Robert Teo, pers. comm.), another individual was photographed in June 2005.

Family Vespertilionidae

***Kerivoula hardwickii* (Horsfield)**
Hardwicke's woolly bat (Fig. 67)

Remarks. The presence of this bat on Pulau Tekong was confirmed in October 2012, from eight examples obtained in a harp trap placed in the middle of a forest trail in the north-central part of the island (pers. obs.). Way back in 2002, one small bat found roosting in a plastic bag among some shrubs on Pulau Tekong was then mistaken as a whiskered myotis (*Myotis muricola*) (Robert Teo, pers. comm.). The genus *Kerivoula* was recently added to the fauna of Singapore Island based on several individuals of *Kerivoula hardwickii* obtained in the Central Catchment Nature Reserve (Leong & Lim, 2009). The coat colour of the bats on Pulau Tekong is either grey or brown (pers. obs.).

***Murina suilla* (Temminck)**
brown tube-nosed bat (Fig. 68)

Reference. Lim et al., 2008c: 197.
Remarks. This nationally critically endangered bat is known from Singapore on the basis of the single specimen obtained in the northern part of Pulau Tekong in January 2002 (Lim et al., 2008c; Robert Teo, pers. comm.). Two more examples were taken in a harp trap in the north-central part of the island in October 2012 (pers. obs.). This species has not been recorded on Singapore Island.

***Myotis* cf. *adversus* (Temminck)**
grey large-footed myotis (Fig. 69)

Remarks. This greyish bat has large feet and habitually flies low over large bodies of freshwater. It has been observed roosting under a bridge on the north-western side of the island in April 2012 (pers. obs.). We follow Francis (2008) in not recognising the occurrence of *Myotis adversus* in continental Southeast Asia (including Singapore). Local examples may be the Horsfield's myotis (*Myotis horsfieldii*), a species recently recorded from Singapore (Lim & Leong, 2014), but specimens are required to confirm the identity.

***Scotophilus kuhlii* Leach**
lesser yellow house bat (Fig. 70)

Remarks. A common bat that is seen regularly throughout Pulau Tekong, particularly over open fields (pers. obs.). It roosts gregariously in the roof spaces of buildings on the island.

Order Carnivora

Family Ursidae

Helarctos malayanus (Raffles)
Malayan sun bear

References. Anonymous, 1990: 5; Sivasothi, 1996: 27.
Remarks. The rumoured occurrence of a sun bear at the north coast between 1987 and 1988, although plausible, has never been confirmed.

Family Canidae

***Canis familiaris* Linnaeus**
domestic dog

Remarks. Up to five individuals of feral dog was been observed at the southern reclaimed land in September 2011, and three were noted on the western end of the island in July 2012 (pers. obs.). Domestic dogs were also recorded by a camera trap on the eastern end of the island (pers. obs.).

Family Mustelidae

***Aonyx cinereus* (Illiger)**
Oriental small-clawed otter (Fig. 71)

References. Yang et al., 1990: 13 (as *Aonyx cinerea cinerea*); Ho et al., 1994: 266 (as *Amblonyx cinerea*); Ng et al., 1995: 154; Sivasothi, 1996: 23−24 (records from 1986 to 1995, as *Amblonyx cinereus*); Subaraj, 1996: 5; Baker & Lim, 2012: 154; Lim et al., 2008c: 199. Except where indicated otherwise, all records as *Aonyx cinerea*.
Remarks. The nationally critically endangered small-clawed otter was recorded several times on Pulau Tekong in 1986, 1989, 1994 and 1995, largely from the western part of the island (Sivasothi, 1996; Lim et al., 2008c). Subsequently, a group of five was observed once along a mangrove-lined stream on the western side of Pulau Tekong in December 2005, and a group of seven was photographed at the eastern side in Aug.2006 (Baker & Lim, 2012: 154). Most recently, in August 2012, three were photographed by camera trap in the same area (Fig. 71).

Lutrogale perspicillata (Geoffroy)
smooth-coated otter

Remarks. Examples of this species are often encountered along the northern coastline of Singapore Island and at Pulau Ubin. However, none was ever reported from Pulau Tekong, except for the carcass of one large otter sighted, but not photographed, floating at sea off the island on the morning of 26 August 2010 (Serena Teo, pers. comm.).

Family Felidae

***Felis catus* Linnaeus**
domestic cat

Remarks. Feral cats have been seen and recorded by camera traps on a few occasions in 2011 and 2012 (pers. obs.). One example was found in an area within the vicinity of leopard cats, but interactions between the two species have not been observed.

***Prionailurus bengalensis* (Kerr)**
leopard cat (Fig. 72)

References. Ng et al., 1995: 153 (as *Felis bengalensis tingia*); Lim, 2006: 3; Baker & Lim, 2012: 151; Lim et al., 2008c: 201; Chua et al., 2016.
Remarks. This small feline has been recorded throughout Pulau Tekong, in secondary forest, planted areas, as well as the reclaimed land in the south (Chua et al., 2016). It was regularly observed on nocturnal surveys conducted in 2005 and 2006, and in 2011 and 2012 (pers. obs.). A population estimate of 21 ± 4.04 (SE) adult individuals and a population density estimate of 89.4 ± 17.2 (SE) individuals/100 km^2 were derived using camera trap capture-recapture analysis (Chua et al., 2016). Although regarded as critically endangered in Singapore (Lim et al., 2008c), there appears to be a stable breeding population on Pulau Tekong.

Panthera pardus (Linnaeus)
leopard

References. Anonymous, 1990: 6 (old jetty between 1987 and 1988); Yang et al., 1990: 15 (refers to Lo & Lim, 1990, as *Panthera pardus fusca*); Yeo, 1991: 1 (near Sg. Belang mangroves in February 1991); Sivasothi, 1996: 27; Subaraj, 1996: 4 (sightings by workers, footprints on Permatang Beach, as 'leopard').
Remarks. A 'black panther' was said to be regularly seen sleeping in a tree at the 'old jetty' by villagers between 1987 and 1988 (Anonymous, 1990). Another example was reported near Belang mangroves in February 1991 (Yeo, 1991). There were also sightings by workers and reports of foot prints at Permatang Beach on the north-western end by army personnel (Subaraj, 1996). Despite these reports, there is no photographic evidence of the occurrence of the panther on Pulau Tekong.

Panthera tigris (Linnaeus)
tiger

References. Ridley, 1895: 89 (as *Felis tigris*); Yang et al., 1990: 15 (as *Panthera tigris corbetti*).
Remarks. According to Ridley (1895: 89), tigers 'habitually swim over to Singapore, across the Johore Strait, usually by way of the intermediate islands of Pulau Ubin and Pulau Tekong'. There is otherwise no actual record of this animal from the island.

Fig. 70–75. 70, *Scotophilus kuhlii* of about 5 cm FAL, northeast, 25 June 2005. 71, *Aonyx cinereus* of about 40 cm HBL, northeast, 18 August 2012. 72, *Prionailurus bengalensis* of about 40 cm HBL, northeast, 29 January 2012. 73, *Sus scrofa* of about 1.5 m HBL, northwest, 31 December 2011. 74, *Rattus tanezumi* of about 20 cm HBL, northeast, 19 November 2011. 75, *Hystrix brachyura* of about 70 cm HBL, northwest, 18 December 2005. Photograph by: Chan Kwok Wai [70], Marcus A. H. Chua [71 (camera trap photo), 72], Vilma D'Rozario [73, 74], Norman T-L. Lim [75; camera trap photo].

Family Viverridae

Paguma larvata (Smith)
masked palm civet

References. Teo & Rajathurai, 1997: 370 (Tekong in 1990, as *Paguma larvata jourdainii*); Lim et al., 2008c: 200 (Tekong record from 1990).
Remarks. Apart from a dubious record in 1990 (Teo & Rajathurai, 1997), a contractor on Pulau Tekong had reported seeing 'musangs' on the island (pers. comm. to Robert Teo in March 2006). Until substantial evidence becomes available, the presence of the 'musang', suggesting the masked palm civet or the curiously unrecorded common palm civet (*Paradoxurus musangus*), on Pulau Tekong is treated as unconfirmed.

Viverra sp.

References. Yeo, 1991: 1 (regularly foraged near Camp I in February 1991, as *Viverra tangalunga*); Ho et al., 1994: 267 (as *Viverra zibetha pruinosa*); Subaraj, 1996: 5 (observed raiding rubbish tips at camp by army personnel, as 'large Indian civet'); Teo & Rajathurai, 1997: 370 (as *Viverra tangalunga tangalunga*); Lim et al., 2008c: 201 (critically endangered in Singapore, as *Viverra zibetha*).
Remarks. The presence of a large ground dwelling civet on Pulau Tekong is based on one unsubstantiated sighting in 1991 (Yeo, 1991). It is likely to be either *V. tangalunga* (the Malay civet) or *V. zibetha* (the large Indian civet). There have been no subsequent records, and this taxon remains unverified.

Order Artiodactyla

Family Suidae

***Sus scrofa* Linnaeus**
wild pig (Fig. 73)

References. Anonymous, 1988a: 15 (four records in 1986); Anonymous, 1988b: 26 (5 at Tg. Petemin on 12 June 1988); Anonymous, 1989a: 17 (2 piglets captured in June 1989); Anonymous, 1989b: 37 (2 records in August 1989); Yang et al., 1990: 16 (as *Sus scrofa peninsularis*); Yeo, 1991: 2 (herd of 40–50 in January 1991); Yeo & Lim, 1992: 2 (3 at Unum on 19 February 1992); Sivasothi, 1996: 27; Subaraj, 1996: 5; Lim, 2006: 4 (as 'wild boar'); Baker & Lim, 2012: 154.
Remarks. The presence of the wild pig on Pulau Tekong has been known since 1986, and a herd of 40 to 50 was even reported in January 1991 (Yeo, 1991). To minimise conflict with humans and military activity, the potentially large wild pig population on Pulau Tekong is carefully managed by the authorities (Anonymous, 1999). Examples, including sows with juveniles, have been observed regularly during surveys in 2005 and 2006, and in 2011 and 2012 (pers. obs.). Pigs were seen throughout the island, including the southern reclaimed land.

Family Cervidae

Rusa unicolor (Kerr)
sambar

References. Chasen, 1924: 85 (as *Cervus equinus*); Yang et al., 1990: 17 (as *Cervus unicolor equinus*).
Remarks. Apart from the claim by Chasen (1924: 85) that 'animals from Johor occasionally visited Pulau Tekong', there seems to be no other record of this large deer from the island. Although recruitment of animals from Johor still seems possible, no sambar has been reported on Pulau Tekong for the past three decades.

Muntiacus muntjak (Zimmermann)
red barking deer

Remarks. A 'barking deer' was seen at one of the newly constructed drains by a contractor (pers. comm. to Robert Teo in March 2006). Although entirely plausible, the presence of this species on Pulau Tekong is yet to be confirmed.

Order Proboscidea

Family Elephantidae

***Elephas maximus* Linnaeus**
Asian elephant

References. Anonymous, 1990: 6 (3 bulls visited in May 1990); Yang et al., 1990: 16, pl. 18 (as *Elephas maximus indicus*); Sivasothi, 1996: 27; Subaraj, 1996: 4.
Remarks. A brief visit by three young bull elephants to Pulau Tekong in May 1990 and their immediate capture and repatriation to Malaysia was well documented by the local media (e.g., Saini, 1990).

Order Rodentia

Family Sciuridae

***Callosciurus notatus* (Boddaert)**
plantain squirrel

References. Anonymous, 1988a: 13; Yang et al., 1990: 10 (as *Callosciurus notatus singapurensis*); Subaraj, 1996: 11 (as 'plantain squirrel'); Lim, 2006: 3 (as 'plantain squirrel').
Remarks. The plantain squirrel appears to be uncommon but widespread on Pulau Tekong (pers. obs. in 2005, 2011 and 2012).

Family Muridae

***Rattus exulans* (Peale)**
Polynesian rat

Reference. Baker & Lim, 2012: 139 (as *Mus musculus*).
Remarks. The small murid photographed in a building in March 2006 by Norman Lim (and appearing as '*Mus musculus*' in Baker & Lim, 2012: 139) is likely to be a Polynesian rat instead. The eyes and head seem a little too large (in proportion to the body) for a mouse.

Rattus norvegicus (Berkenhout)
brown rat

Remarks. Large rat with coarse brown or dark grey fur above and paler underparts. It has been observed in urban areas on the island (Grace Yap, pers. comm.).

***Rattus tanezumi* Temminck**
Oriental house rat (Fig. 74)

Remarks. Shaggy-haired rats that are olive-brown above and grey on the underside are referred to this species. Examples of various sizes have been observed in cultivated trees at the eastern end of Pulau Tekong in 2011 and 2012 (pers. obs.).

Family Hystricidae

***Hystrix brachyura* Linnaeus**
Malayan porcupine (Fig. 75)

References. Lim, 2006: 3–5 (one camera trapped in December 2005); Baker & Lim, 2012: 142; Lim et al., 2008c: 207.
Remarks. The Malayan porcupine was recorded on two occasions by camera traps on the western side of Pulau Tekong. The first was sighted, then photographed over two nights in December 2005 (Fig. 75); and also in February 2006 (pers. obs.). The second was photographed in April 2012 (pers. obs.). Listed as critically endangered in Singapore (Lim et al., 2008c).

DISCUSSION

The non-avian terrestrial and freshwater vertebrate fauna of Pulau Tekong is quite diverse and interesting. With a mix of native and introduced species, it contains the following: freshwater fishes—18 spp. (7 spp. introduced); amphibians—15 spp. (at least 2 spp. introduced); reptiles—45 spp. (at least 2 spp. introduced); mammals—31 spp. (20 spp. confirmed, at least 2 spp. introduced).

A large part of the non-avian vertebrate fauna on Pulau Tekong consists of human commensals that are typically found living close to or in association with human-modified habitats (see Baker & Lim, 2012; Das, 2010; Francis, 2008). These include the fishes such as *Trichopodus trichopterus*, *Channa striata*, *Clarias batrachus*; the frogs *Duttaphrynus melanostictus*, *Hylarana erythraea*, *Fejervarya* spp., *Polypedates leucomystax*, *Microhyla* spp., *Kaloula pulchra*; the lizards *Hemidactylus frenatus*, *Hemidactylus platyurus*, *Gehyra mutilata*, *Gekko monarchus*, *Lygosoma bowringii*; at least one snake *Lycodon capucinus*; the bats *Scotophilus kuhlii*, *Saccolaimus saccolaimus*, *Cynopterus brachyotis*; and the rats *Rattus tanezumi*, *Rattus exulans*. The occurrence of these species may be because Pulau Tekong Besar had a fairly large human population (up to around 5,000), and most of the island's original lowland dipterocarp forest had been cleared for crop cultivation (see Chen & Lee, 2012: 19). The habitat modification and human settlement may have allowed human commensal species to colonise much of the island.

However, despite the massive deforestation, fragments of natural vegetation must have been left intact for many small forest dwelling animals to have survived. Many of these native forms are more or less specialists of lowland freshwater swamp-forest (see Baker & Lim, 2012; Francis, 2008). They include the fishes *Rasbora einthovenii*, *Clarias nieuhofii*; the frogs *Limnonectes paramacrodon*, *Hylarana baramica*, *Occidozyga sumatranus* and *Ingerophrynus quadriporcatus*; the lizard *Cyrtodactylus pantiensis*; the bats *Rhinolophus trifoliatus* and *Kerivoula hardwickii*. The occurrence of the viper *Cryptelytrops purpureomaculatus* may suggest that the health of original shore vegetation and mangroves is good.

Some animals on Pulau Tekong are rare on Singapore Island, and known to occur there only from the mature forests of the Bukit Timah Nature Reserve and Central Catchment Nature Reserve. These include the fish *Channa gachua*; the frog *Limnonectes paramacrodon*; the snakes *Lycodon subcinctus*, *Boiga jaspidea* and *Tropidolaemus wagleri*; the lizard *Cnemaspis peninsularis*; the slow loris *Nycticebus coucang*, and the bats *Rhinolophus trifoliatus* and *Kerivoula hardwickii*. The frog and the bats in particular, occur only in the area of the Nee Soon swamp-forest on Singapore Island (Teo & Rajathurai, 1997; Leong & Lim, 2009; Lim & Leong, 2008; Lim et al, 2008a–c).

In general, the non-avian vertebrate fauna of Pulau Tekong is a subset of that found on Singapore Island. Curiously, though, Singapore records of the lizards: *Ptychozoon kuhli*, *Luperosaurus browni*, *Cyrtodactylus pantiensis* and the bat: *Murina suilla* are known only from Pulau Tekong (Baker & Lim, 2012; Lim et al., 2008b, c). None of these had ever been recorded in Singapore territory beyond Pulau Tekong. The absence of these from Singapore Island may suggest that suitable microhabitat is lacking, or that Pulau Tekong is the furthest edge of their range in the Malay Peninsula. It is also possible that they are on Singapore Island, but are so rare that they have not yet been discovered there. However, *Ptychozoon kuhli*, *Cyrtodactylus pantiensis* and *Murina suilla* appear to be not uncommon on Tekong. *Luperosaurus browni* seems to be an exceedingly cryptic or rare lizard, with only three records to date from the entire Malay Peninsula (Grismer, 2011: 517).

On the other hand, some animals that are common on Singapore Island appear to be absent on Pulau Tekong. Strangely, there are no records of the common treeshrew (*Tupaia glis*) and the Sunda colugo (*Galeopterus variegatus*). The Sunda colugo has been erroneously cited as occurring on Pulau Tekong by Ng et al. (1995: 146 as *Cynocephalus variegatus peninsulae*). The source of this error is from the account of an encounter with this animal by Lim (1988: 23) at 'Mandai Tekong', which is actually in the Mandai area on Singapore Island. Suitable habitat for these two species appears to be available. Records are markedly absent of the common palm civet (*Paradoxurus musangus*) and the greater mousedeer (*Tragulus napu*), which are found across forest fragments on Pulau Ubin (Chua et al., 2009; Chua et al., 2012). Records of *Rattus annandalei* and *Rattus tiomanicus,* common rats of wooded areas on Singapore Island (Yang et al., 1990; Baker & Lim, 2012), are also curiously lacking on Tekong.

Pulau Tekong is situated closer to the south-eastern corner of mainland Malay Peninsula than to Singapore Island, with the narrowest channel of sea only about 1.5 km wide (Fig. 1). Its distance from Changi, the nearest part of Singapore Island, by comparison, is about 3 km. Pulau Tekong is said to be a stepping stone for tigers that dispersed from Johor to Singapore (Ridley, 1895), and indeed this is shown by the proliferation of wild pigs at least since the 1980s, and the appearance of three elephants in 1990. They were probably forced to swim across the Johor Straits by land development and deforestation on the opposite bank in Johor. Unconfirmed sightings of leopards, bears and barking deer on Tekong may be attributed to the same pressure. Although unrecorded, it is not impossible for smaller animals to make their way to Tekong by swimming across from Johor. Such dispersal movement may have been (and probably still is being) undertaken by leopard cats, pangolins, porcupines and large snakes like the reticulated python, the king cobra and the gold-ringed cat snake. A Malayan tapir (*Tapirus indicus*) seen at Changi North in June 2016 (Cheong, 2016) had most likely swam across from Johor, and it could have set foot on Pulau Tekong enroute to Singapore Island.

Pulau Tekong supports thriving populations of the leopard cat *Prionailurus bengalensis*, the slow loris *Nycticebus coucang*, and the pangolin *Manis javanica*; mammals that are regarded to be rare and endangered in Singapore (Lim et al., 2008c). As Pulau Tekong is managed by the military, public access is largely restricted and much of it kept wooded, creating favourable living conditions for these animals. The leopard cat, slow loris and pangolin are not dependant on pristine forest, and seem to tolerate human modified natural habitats (Francis, 2008), but they evidently fare better without (or with minimal) human exploitation and low vehicular traffic (Haines et al., 2004; Lim & Ng, 2007; Nekaris et al., 2008). All three species, especially the pangolin, have been known to fall victim to speeding vehicles on Singapore Island (Wee, 2001; Osman, 2008).

As with any place that is (or was) inhabited by humans, Pulau Tekong has its fair share of alien biodiversity. At least 14 species of terrestrial non-avian vertebrates are recorded, seven of them are freshwater fish (see Baker & Lim, 2012; Ng & Tan, 2010). A number of these alien fishes (*Puntigrus tetrazona*, *Geophagus altifrons*, *Oreochromis mossambicus*, *Clarias gariepinus*, *Oxyeleotris marmorata*) were introduced to the reservoir apparently by the authorities. A population of the swordtail (*Xiphophorus helleri*) was found in a large, disused well. The frog *Microhyla fissipes* appears to be introduced. The banded bull-frog *Kaloula pulchra* and the changeable lizard *Calotes versicolor* were probably not introduced deliberately, but had perhaps hitched a ride with supplies from Singapore Island. The red-eared slider *Trachemys scripta elegans* and feral dogs and cats could have been abandoned pets, or their descendants. With the

possible exception of *Clarias gariepinus* and *Trachemys scripta elegans*, the other introduced species have established feral populations on Pulau Tekong. It seems possible that many of the commensal species on Pulau Tekong treated herein as native (e.g., *Duttaphrynus melanostictus*, *Fejervarya limnocharis*, *Lycodon capucinus*, *Hemidactylus frenatus*, *Lygosoma bowringii*, *Draco sumatranus*, *Rattus tanezumi*) are not original inhabitants of the island, but were brought there by humans. These animals are usually found in association with humans, and very rarely in areas of undisturbed original natural vegetation. The effects of alien species on the original native biodiversity on Pulau Tekong are not known, and have not been studied.

A part of the reclaimed land that forms the southern half of Pulau Tekong was completed by 1987 (Anonymous, 1987), and has been covered with pioneer vegetation, with some areas becoming dense scrubland and secondary forest. Animals that are specialised for life in swamp-forests are unlikely to spread into that area. Those that can tolerate exposure and hotter, drier conditions appeared to have colonised this novel landscape. These include the human commensals, as well as some of the larger species, such as the wild pig and the leopard cat, as well as the pangolin.

It appears that present land use of Pulau Tekong has helped in the conservation of the terrestrial mammal, freshwater fish and herpetofauna on the island. Since 1987, most of Pulau Tekong has been devoted for military use (Anonymous, 1987). Future plans include the consolidation of the island for military activities, an infrastructure development, and a portion of reclaimed land designated as a reserve site (Chang, 2013; Ministry of National Development, 2013). While some form of development of Pulau Tekong is not likely to be avoided, it is hoped that at least the northern half (i.e., Pulau Tekong Besar) will continue to be used as a military area, or at least have substantial areas of natural vegetation set aside as a wildlife refuge, with biodiversity taken into consideration during development planning. As only this will help insure the survival of the island's interesting and nationally threatened fauna.

ACKNOWLEDGEMENTS

We thank the Ministry of Defence and the National Parks Board (permit no. NP/RP10-086), without whose kind permission to conduct biodiversity research on Pulau Tekong and for their generous support, this report would not have been possible. There was hardly any historical information on the non-avian terrestrial vertebrate fauna of Pulau Tekong. For sharing data acquired on their respective surveys on the island, we are especially grateful to Robert C. H. Teo and R. Subaraj; and to Grace Yap from the National Environment Agency. Cheryl S. W. Chia from the National Biodiversity Centre (National Parks Board) assisted with additional information. Peter K. L. Ng and N. Sivasothi initiated and supervised the pangolin and leopard cat surveys that also enabled other forms of Tekong's biodiversity to be studied. A number of records presented in this article were obtained during a study of the ecology of leopard cats in Singapore funded by the Wildlife Reserve Singapore Conservation Grant. L. Lee Grismer helped identify the bent-toed gecko as a new Singapore record.

We acknowledge the contributions of observations and voucher material by the following individuals who have participated in the various biodiversity surveys on Pulau Tekong since 2001: Airani Ramli, Alvin F. S. L. Lok, Andrew Tham, Alan Tan, Andrew Tay, Alan Yeo, Benjamin Y. H. Lee, Chim Chee Kong, Chan Kwok Wai, Celine H. S. Low, Choy Ming Shen, Chew Ping Ting, S. P. Chng, Darren C. J. Yeo, Francis L. K. Lim, Hugh T. W. Tan, Jean Yong, Joelle C. Y. Lai, Khew Sin Khoon, Lee King Li, Lioe Kim Swee, Leong Tzi Ming, Lin Yangchen, N. Sivasothi, Nick Baker, Ng Heok Hee, Paul Chen, Robert C. H. Teo, Robin Ngiam, Ron K. H. Yeo, Serena L. M. Teo, Steven Neo, R. Subaraj, Tommy H. T. Tan, Tan Heok Hui, Tan Kai-xin, Tan Siong Kiat, Timothy K. A. Pwee, Vilma D'Rozario, Wang Luan Keng, Yang Chang Man, Yeo Suay Hwee and Zeehan Jafaar.

The following are acknowledged for their kind contribution of photographs to this publication: Nick Baker, Chan Kwok Wai, Chim Chee Kong, Francis L. K. Lim, Celine H. S. Low, Vilma D'Rozario, Tan Siong Kiat, Robert C. H. Teo, Alan W. M. Yeo and Yeo Suay Hwee.

LITERATURE CITED

Anonymous, 1978. Pulau Tekong gets go ahead. The Straits Times, 23 December 1978. P. 38.
Anonymous, 1987. Tekong to be Main SAF Training Area. The Straits Times, 30 July 1987. P. 17.
Anonymous, 1988a. Some past mammal reports. The Pangolin, 1(1): 11–16.
Anonymous, 1988b. Recent reports. The Pangolin, 1 (2): 26–35.
Anonymous, 1989a. Recent reports. The Pangolin, 2 (2): 17–26.
Anonymous, 1989b. Recent reports. The Pangolin, 2 (3): 36–43.
Anonymous, 1990. Singapore records for the year. The Pangolin, 3 (1–4): 3–15.
Anonymous, 1999. SAF to kill wild boars on Pulau Tekong. The Straits Times, 25 March 1999.

Baker N & Lim KKP (2012) Wild Animals of Singapore. A Photographic Guide to Mammals, Reptiles, Amphibians and Freshwater Fishes. Updated Edition. Draco Publishing and Distribution Pte. Ltd and Nature Society (Singapore), Singapore, 180 pp.

Chang R (2013) Plan to grow space for rising population. The Straits Times, 1 February 2013. P. A1.

Chasen FN (1924) A preliminary account of the mammals of Singapore Island. The Singapore Naturalist, 3: 76–86.

Chen PS & Lee LS (2012) A Retrospect on the Dust-laden History. The Past and Present of Tekong Island in Singapore. World Scientific Publishing Cp. Pte. Ltd., Singapore, 121 pp.

Cheong F (2016) Malayan tapir at Changi North. Singapore Biodiversity Records, 2016: 94–95.

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

Chua MAH, Lim KKP & Low CHS (2012) The diversity and status of the civets (Viverridae) of Singapore. Small Carnivore Conservation, 47: 1–10.

Chua MAH, Sivasothi N & Meier R (2016) Population density, spatiotemporal use and diet of the leopard cat (*Prionailurus bengalensis*) in a human-modified succession forest landscape of Singapore. Mammal Research, 61: 99–108.

Das I (2010) A Field Guide to the Reptiles of South-east Asia. New Holland Publishers (UK) Ltd 376 pp.

Duckworth J, Pattanavibool A, Newton P & Nguyen V (2008) *Manis javanica*. In: IUCN (2013) IUCN Red List of Threatened Species. Version 2013.1. http://www.iucnredlist.org/details/12763 /0 (Accessed 23 July 2013).

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

Grismer LL (2011) Lizards of Peninsular Malaysia, Singapore, and their Adjacent Archipelagos. Their Description, Distribution, and Natural History. Edition Chimaira, Frankfurt am Main, 728 pp.

Grismer LL, Wood PL Jr, Shahrul A, Riyanto A, Norhayati A, Mohd AM, Sumontha M, Grismer JL, Chan KO, Quah ESH & Pauwels OSA (2014) Systematics and natural history of Southeast Asian rock geckos (genus *Cnemaspis* Strauch, 1887) with descriptions of eight new species from Malaysia, Thailand, and Indonesia. Zootaxa, 3880(1): 1–147.

Haines AM, Grassman LI Jr & Tewes ME (2004) Survival of radiocollared adult leopard cats *Prionailurus bengalensis* in Thailand. Acta Theriologica, 49(3): 349–356.

Ho HC, Subaraj R, Yeo SH & Yang CM (1994) Mammals. In: Ng PKL & YC Wee (eds.) The Singapore Red Data Book – Threatened Plants and Animals of Singapore. First Edition. Pp. 248–267.

Kottelat M (2013) The fishes of the inland waters of Southeast Asia: a catalogue and core bibliography of the fishes known to occur in freshwaters, mangroves and estuaries. The Raffles Bulletin of Zoology, Supplement No. 27: 1–663.

Law IS (2015) First record of East Asian ornate chorus frog on Singapore Island. Singapore Biodiversity Records, 2015: 30.

Leong TM & Chou LM (1999) Larval diversity and development in the Singapore Anura (Amphibia). The Raffles Bulletin of Zoology, 47(1): 81–137.

Leong TM & Lim KKP (2009) Noteworthy microchiropteran records from the Bukit Timah and Central Catchment Nature Reserves, Singapore. Nature in Singapore, 2: 83–90.

Lim F (1988) An encounter with a flying lemur at Mandai Tekong. The Pangolin, 1(1): 23.

Lim KKP (1991) Records for the first quarter, 1991: reptiles & amphibians. The Pangolin, 4(1): 3–5.

Lim KKP (1994) Reptiles. In: Ng PKL & Wee YC (eds.) The Singapore Red Data Book – Threatened Plants and Animals of Singapore. First Edition. Pp. 213–227.

Lim KKP & Leong TM (2008) Amphibians. In: Davison GWH, Ng PKL & Ho HC (eds.) The Singapore Red Data Book – Threatened Plants and Animals of Singapore. Second Edition. Pp. 155–159.

Lim KKP & Leong TM (2014) New record of the Horsfield's large-footed myotis in Singapore. Singapore Biodiversity Records, 2014: 106–107.

Lim KKP & Lim NT-L (2006) Geographic distribution: *Luperosaurus browni*. Herpetological Review, 37(1): 107.

Lim KKP, Baker N, Teo R & Leong TM (2008b) Reptiles. In: Davison GWH, Ng PKL & Ho HC (eds.) The Singapore Red Data Book – Threatened Plants and Animals of Singapore. Second Edition. Pp. 160–176.

Lim KKP, Leong TM & Lim FLK (2011) The king cobra, *Ophiophagus hannah* (Cantor) in Singapore (Reptilia: Squamata: Elapidae). Nature in Singapore, 4: 143–156.

Lim KKP, Subaraj R & Sivasothi N (1996) Recent records (for 1994). The Pangolin, 7 (1–4): 1–15.

Lim KKP, Subaraj R, Yeo SH, Lim N, Lane D & Lee BYH (2008c) Mammals. In: Davison GWH, Ng PKL & Ho HC (eds.). The Singapore Red Data Book – Threatened Plants and Animals of Singapore. Second Edition. Pp. 190–207.

Lim KKP, Tan HH & Low JKY (2008a) Fishes. In: Davison GWH, Ng PKL & Ho HC (eds.). The Singapore Red Data Book – Threatened Plants and Animals of Singapore. Second Edition. Pp. 145–154.

Lim N (2006) Pulau Tekong's spiny surprise. Nature Watch, 4(2): 2–7.

Lim N (2007) Island life. Discovering the wild side of Singapore. The Muse, August 2007: 38–43.

Lim NT-L & Ng PKL (2007) Home range, activity cycle and natal den usage of a female Sunda pangolin *Manis javanica* (Mammalia: Pholidota) in Singapore. Endangered Species Research, 3: 111–118.

Lim NT-L, Yeo AWM & Chan K-W (2006) Geographic distribution: *Microhyla fissipes*. Herpetological Review, 37(1): 101.

Lo TY & Lim T (1990) Panther may be living on island. The New Paper, 1 June 1990.

Ministry of National Development (2013) A High Quality Living Environment for All Singaporeans: Land Use Plan to Support Singapore's Future Population. Ministry of National Development, Singapore, 80 pp.

Natural Areas Survey Team (2008) A Rapid Biodiversity Assessment of Pulau Tekong. National Biodiversity Reference Centre, National Parks Board, Singapore, 51 pp.

Nekaris KAI, Blackham GV & Nijman V (2008) Conservation implications of low encounter rates of five nocturnal primate species (*Nycticebus* spp.) in Asia. Biodiversity Conservation, 17: 733–747.

Nekaris A & Streicher U (2008) *Nycticebus coucang*. In: IUCN (2013) IUCN Red List of Threatened Species. Version 2013.1. http://www.iucnredlist.org/details/39759/0 (Accessed 23 July 2013).

Ng HH & Tan HH (2010) An annotated checklist of non-native freshwater fish species in the reservoirs of Singapore. COSMOS. 6(1): 95–116.

Ng TH & Lim KKP (2010) Introduced aquatic herpetofauna of Singapore's reservoirs. COSMOS, 6(1): 117–127.

Ng TH & Yeo DCJ (2012) Non-indigenous frogs in Singapore. Nature in Singapore, 5: 95–102.

Ng PKL & Lim KKP (1996) The freshwater fishes of Singapore. Journal of the Singapore National Academy of Science, 22–24: 109–124.

Ng PKL, Murphy DH, Lim KKP, Chou LM & Lane DJW (1995) A Guide to the Threatened Animals of Singapore. Singapore Science Centre, 160 pp.

Osman D (2008) Pangolin roadkill: strayed too far in search of supper? The Straits Times, 17 August 2008.

Ridley HN (1895) The mammals of the Malay Peninsula. Natural Science, 6(35, 36, 37): 23–29, 89–96, 161–166.

Saini R (1990) Wanted: tusk force to catch wild elephants on Tekong. The Straits Times, 31 May 1990.

Sivasothi N (1996) A family group of the small-clawed otter, *Amblonyx cinereus* (Illiger, 1815) (Carnivora: Mustelidae: Lutrinae), on Pulau Tekong Besar, the second resident wild carnivore in Singapore. The Pangolin, 7: 23–31.

Subaraj R (1996) A Report on the Vertebrate Fauna of Pulau Tekong Besar. Unpublished report for the Vertebrate Group, The Nature Society (Singapore), 13 pp.

Subaraj R, Serin S & Saker S (2016) East Asian ornate chorus frogs at Lorong Halus. Singapore Biodiversity Records, 2016: 30–31.

Sworder GH (1924) On a few reptiles and batrachians from the Singapore islands. The Singapore Naturalist, 3: 15–20.

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

Wee L (2001) Leopard-cat find may shed light on species. The Straits Times, 22 July 2001. Pp. 28.

Wu ZB (1971) Population and Usage of Land on Tekong Island. Unpublished Honours Thesis. Nanyang University, 51 pp. [In Chinese].

Yang CM, Yong K & Lim KKP (1990) Wild mammals of Singapore. In: Chou LM & Ng PKL (eds.) Essays in Zoology. Department of Zoology, National University of Singapore. Pp. 1–23.

Yee ATK, Corlett RT, Liew SC & Tan HTW (2011) The vegetation of Singapore – an updated map. The Gardens' Bulletin, Singapore. 63(1&2): 205–212.

Yeo SH & Lim KKP (1992) Current records: mammals. The Pangolin, 5 (1–4): 1–5.

Yeo SH (1991) Records for the first quarter, 1991: mammals. The Pangolin, 4(1): 1–3.