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COMMUNICATION

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The diversity of small mammals in Pulau Perhentian Kecil, Terengganu, Malaysia

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Abstract: Islands are generally rich in marine biodiversity, but it also often hides unique and endemic terrestrial wildlife. The data of terrestrial wildlife in Malaysian islands are still severely lacking, notably from small islands. Hence, this study was conducted to survey and update the small mammal diversity (bats and non-volant small mammals) in Pulau Perhentian Kecil, a tourist destination famous for its magnificent, diverse marine life and white sandy beaches. Despite their touristic popularity, very few information is known about the faunal diversity in this island compare to their more massive neighbouring island, Pulau Perhentian Besar. The survey was carried out from 21 to 30 May 2014 recorded 56 individuals encompasses eight species of bats and five species of non-volant small mammals that were captured using mist nets, harp traps, and cage traps. The survey recorded 10 new species locality records for the island in which, five species were never recorded in Pulau Perhentian Besar. *Hipposideros dyacorum*, *Tylonycteris fulvida*, *T. malayana*, *Rattus exulans*, and *Sundamys annandalei* are also new distribution records for the Malaysian East Coast islands highlighting the importance of protecting island biodiversity. Nonetheless, it is hoped that this study not only highlights the species diversity on the island but also serve as a data for sustainable island tourism management planning, which will be crucial for the sustainable development and management of this ecologically sensitive area.

Keywords: Ecology, endemic species, island biogeography, South China Sea, tourism, wildlife.

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INTRODUCTION

Oceanic islands are well known to contain unique and endemic wildlife, contributing disproportionately 15–20 % of global terrestrial species which are available in one of the 3.5% planet's offshore landmass (Whittaker et al. 2017). Data on island mammals (bats and non-volant small mammals) in Malaysia are uncommon especially for small islands like Pulau Perhentian Kecil (Roslan et al. 2016; Jayaraj et al. 2019). Bats are found throughout the world continents except Antarctica with the highest diversity in equatorial territories (Taylor 2019). The wide distribution of bats coupled with the ability of flight allows bats to fill a plethora of niches making them the second most diverse group of mammals with 110 bat species documented in the Peninsular Malaysia alone (Lim et al. 2017). On top of that, bats are often the main native island mammals, providing seed dispersal and pollination services with their added mobility like flying foxes (Fujita & Turtle 1991).

In islands where there are other small mammals, they play ecological roles including consuming invertebrates and plant materials alongside becoming the prominent prey base for many predators (Pimsai et al. 2014). Malaysian non-volant small mammal diversity reports on islands remain limited by effort and funding simply because island trips are costly and climatic events are unpredictable. Past attempts have provided benchmarks but, due to irregular monitoring, species checklist on islands requires updating (Rahim et al. 2016). The data on the island mammals are not just important for planning conservation frameworks but also assessing introduced species and its estimated damage caused. One of the common introduced mammal culprits are rodents, causing harm to the natives to the point of extinction in islands all around the world such as New Zealand, French Polynesia, and Lord Howe Island, Australia (Towns et al. 2006; Harper & Bunbury 2015).

Threats facing island mammals including bats are mainly habitat loss and human disturbance (Jones et al. 2009). These threats are due to rapid growth of the tourism industry, which has put significant pressure on natural resources and land use in the Perhentian Islands (Aswani et al. 2018). In light of this lack of research on island mammal diversity in Malaysia, we have conducted a small mammal survey in Pulau Perhentian Kecil, the smaller neighbour and less studied island compared to Pulau Perhentian Besar in the state of Terengganu. This survey was aimed to determine the species diversity and update the mammal checklist on this island. Above all, it is hoped that this study not only highlights the

species diversity on the island but also serve as data for sustainable island tourism management planning.

MATERIAL AND METHODS

Site description

The Perhentian Islands (comprising of islands like Besar, Kecil, Serenggeh, Rawa, Tokong Kemudi, and Susu Dara) are situated 21km seaward from mainland Terengganu with accessibility from towns like Kuala Besut, Merang, and Kuala Nerus. Pulau Perhentian Kecil is approximately 524 hectares (Farhana 2018). These islands are also well-known and popular tourism destinations for their stunning coral reefs and beautiful sandy beaches.

A nine-day study was conducted in Pulau Perhentian Kecil, from 21st till 30th May 2014. Two sampling sites (site A and site B) located in the northern part of the island were chosen for this study, as shown in Figure 1. The southern part of the island was not chosen mainly due to time constraints and the possibly uncontrolled anthropogenic disturbance from Kampung Pasir Hantu, a village settlement located there.

Site A (North end: 5.937°N, 102.720°E, South end: 5.922°N, 102.720°E) is a combination of primary and secondary lowland forest while site B (North end: 5.922°N, 102.720°E, South end: 5.916°N, 102.718°E) is a secondary forested area similar to site A but sandwiched between Perhentian Kecil's main tourist beaches which are Long Beach and Coral Bay. Site B is more subjected to anthropogenic disturbances due to the vicinity to tourist beaches with a main trail frequently used by tourists to travel between the two beaches and small patches of agricultural land mainly for rubber. For both sampling sites, the vegetation gradually changes into typical coastal forest nearing the coast and beaches.

Small mammals sampling

Bats were captured using mist nets (mesh size: 4cm), and harp traps (4 bank, 2m² metal frame) which were placed at suitable bat flyways whereas collapsible cage traps baited with banana were used to capture non-volant small mammals. Both harp traps and mist nets were set up approximately 1m above ground and adjusted to change based on place of trapping. Mist nets and harp traps were checked from 19.00h to 21.00h, closed for the night and reopened and checked from 05.00h to 07.00h in the morning. Cage traps were set placed on a grid of 10m x 10m per trap and checked twice daily with rebait applied for missing or



Figure 1. The location of Perhentian Islands (Pulau Perhentian Kecil & Pulau Perhentian Besar) in Terengganu (inset) and location of sampling sites in Pulau Perhentian Kecil: Site A and Site B.

rotten baits. Opportunistic sightings of small mammals in the sampling sites during netting and trapping were also made whenever possible. The total netting and trapping effort in this study summarized in Table 1. All standard body measurements (vernier caliper & metal ruler), weight (spring balance), gender and maturity state of each captured mammal taken for record and identification purposes based on the identification keys in species identification books (Francis 2008; Kingston et al. 2009). Selected individuals were euthanized and collected as voucher specimens by ethanol preservation (Permit number D-01052-16-19). These were deposited at Faculty of Earth Science, Universiti Malaysia Kelantan. Results are presented in the form of species composition at both sites with assessments of the most recent conservation status of these mammals (IUCN 2020; <https://www.iucnredlist.org/>) and Red List of Mammals for Peninsular Malaysia Version 2.0 (Perhilitan 2017). Lastly, we compared the results of this study with past studies in the Perhentian Islands (Kecil and Besar) plus other Malaysian east-coast islands including Pulau Bidong, Pulau Redang, Pulau Tenggol, and Pulau Tioman.

Statistical analysis

Shannon-Wiener diversity index (H') is used to calculate the species richness of Site A and Site B and compare the diversity of both sites. We used Mann-

Table 1. Total netting and trapping effort for both sites A and B.

Sampling method	Site A	Site B	Time of collection (h)	Total per day/night
Mist nets	15	15	19.00–23.00 & 05.00–07.00	30
Harp traps	5	5	19.00–23.00 & 05.00–07.00	10
Cage traps	150	150	10.00 & 17.00	300
Total effort	170	170		340

Whitney U test to compare the relative abundance of small mammals between sites. To enhance the statistical analyses conducted, we used rarefaction curve to visualize and calculate the species richness for a given number of individual samples. All statistical analyses was calculated using Paleontological Statistics (PAST) software.

RESULTS

A total of 56 individuals belonging to 13 species from six families were recorded in this survey, with site A (12 species, $H' = 2.35$) being more diverse than site B (seven species, $H' = 1.7$). Bats had the highest individual count and species diversity compared to non-volant small mammals. *Pteropus hypomelanus* was also observed

to be abundant on the beaches of Pulau Perhentian Kecil during the sampling period. Civet droppings were also found in site B, but the species was unable to be determined during the sampling period. Both species is not included in our results due to insufficient capture details.

Table 2 shows the species composition of small mammals at both sites in this survey. The total number of small mammals captured in Site A ($n=20$) was lower than the total number of small mammals captured in Site B ($n=36$). The relative abundance of small mammals in Site A and Site B were not statistically significant (Mann Whitney U test, $U=69$, $df=24$, $p>0.05$). The most abundant species caught are *Tupaia glis* and *Rhinolophus affinis* with each totaling to 12 individuals. In contrast, *Eonycteris spelaea*, *Hipposideros dyacorum*, *Tylonycteris fulvida*, *Tylonycteris malayana*, and *Rattus exulans* were recorded as singletons. Among the species captured, *E. spelaea* is listed as Near Threatened while *H. dyacorum* is listed as Data Deficient in the Red List of Mammals for Peninsular Malaysia Version 2.0. Interestingly enough, *H. dyacorum* was previously listed as Endangered for Criteria A (EN A4c) and Criteria B (EN B2ab(ii,iii)) in the Red List version 1 in 2010 (Perhilitan 2017).

When the number of individual small mammals captured was standardized ($n=20$), the rarefaction curve showed that the expected number of species found in Site A was higher than the expected number of species found in Site B (Figure 2). The rarefaction curve reinforces the relative abundance and species diversity results from Shannon-Weiner Index from both sites.

Species Accounts

Family Tupaiidae

Tupaia glis (Diard, 1820) (Common Treeshrew)

A total of 12 individuals were captured in the island with three at site A and nine at site B. The previous study conducted in the Perhentian Islands (Kecil and Besar) recorded a much higher capture at 21 and 56 respectively (Tamblyn et al. 2005). This species was observed throughout Pulau Perhentian Besar, including the island lowland forest, coastal forest and disturbed areas (Turner et al. 2003). It is common throughout Peninsular Malaysia, where individuals captured in Tasik Bera, Ulu Gombak, Pulau Pinang and Wang Kelian State Park (Jayaraj et al. 2013; William-Dee et al. 2019). According to Rahim et al. (2016), this species is not disturbed by tourists walking around the trails and beach and seen moving in their proximity. This diurnal species is commonly found in forests and nearby plantations as well as gardens. Their diet mainly consists

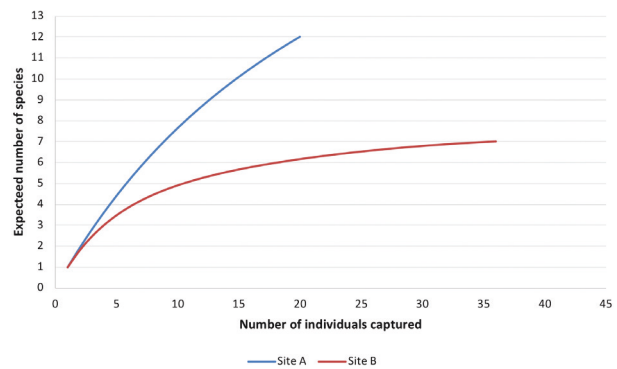


Figure 2. The rarefaction curve for the number of small mammal species in Site A and Site B of Pulau Perhentian Kecil.

of insects and the occasional sweet fruits (Francis 2019). Jayaraj et al. (2015) conducted a phylogenetic analysis on tree shrews of Peninsular Malaysia and described three genetically distinct forms of *T. glis* which coincides with the morphological analysis study from Yusoff et al. (2015). *Tupaia glis* from Perhentian Kecil is provisionally placed under *T. glis* morphotype two pending further taxonomic studies.

Family Pteropodidae

Cynopterus brachyotis (Muller, 1838) (Short-nosed Fruit Bat)

Two individuals were captured in which both were from Site A. This species can be traced back to two distinct lineages which are Sunda lineage (*C. brachyotis*) and Forest lineage (*Cynopterus cf. brachyotis* Forest) by using two regression models from Jayaraj et al. (2012a). The nominate for *C. brachyotis* (see Abdullah & Jayaraj 2006) has been identified to be the form previously described as *C. cf. brachyotis* Sunda (Campbell et al. 2004; Jayaraj et al. 2004). Roslan et al. (2016) recorded 11 captures of this species in Pulau Perhentian Besar in which seven are *C. brachyotis* and three are from *Cynopterus cf. brachyotis* Forest. Other previous studies include three individuals from Pulau Perhentian Kecil, four individuals from Pulau Perhentian Besar and three individuals from Pulau Susu Dara (Tamblyn et al. 2005) while three individuals of *C. brachyotis* from Pulau Perhentian Kecil (Campbell et al. 2004). *Cynopterus brachyotis* occurs in orchards, plantations, and disturbed habitats while *Cynopterus cf. brachyotis* Forest can be found in primary forest. Both *C. brachyotis* and *C. cf. brachyotis* Forest has been known to intersect one another at forest fringes like recorded in Gunung Stong (Jayaraj et al. 2013) and even high up at Mount Penrisen (1,000m) (Jayaraj et al. 2006). The presence of *C. cf. brachyotis* Forest could be attributed to



Table 2. Small mammal species composition in site A and site B.

	Family Species	Site A	RA _i (%)	Site B	RA _i (%)	Total	IUCN (2020)	Perhilitan (2017)
	Tupaiaidae							
1	<i>Tupaia glis</i>	3	15.0	9	25.0	12	LC	LC
	Pteropodidae							
2	<i>Cynopterus brachyotis</i>	2	10.0	0	0.0	2	LC	LC
3	<i>Eonycteris spelaea</i>	1	5.0	0	0.0	1	LC	NT
	Rhinolophidae							
4	<i>Rhinolophus affinis</i>	1	5.0	11	30.6	12	LC	LC
	Hipposideridae							
5	<i>Hipposideros cineraceus</i>	4	20.0	5	13.9	9	LC	LC
6	<i>Hipposideros dyacorum</i>	0	0.0	1	2.8	1	LC	DD
7	<i>Hipposideros larvatus</i>	1	5.0	6	16.7	7	LC	LC
	Vespertilionidae							
8	<i>Tylonycteris fulvida</i>	1	5.0	0	0.0	1	LC	LC
9	<i>Tylonycteris malayana</i>	1	5.0	0	0.0	1	LC	LC
	Muridae							
10	<i>Rattus exulans</i>	1	5.0	0	0.0	1	LC	LC
11	<i>Rattus tanezumi</i>	1	5.0	2	5.6	3	LC	LC
12	<i>Rattus tiomanicus</i>	2	10.0	2	5.6	4	LC	LC
13	<i>Sundamys annandalei</i>	2	10.0	0	0.0	2	LC	LC
	Total individuals	20	100.0	36	100.0	56	-	-
	Shannon-Weiner (H')	2.35		1.7				
	Total species	13		7		13	-	-

RA_i—Relative Abundance | LC—Least Concern | NT—Near Threatened | DD—Data Deficient.

the island lowland forest where *Dipterocarpus* sp. and *Shorea* sp. are dominant (Turner et al. 2003).

***Eonycteris spelaea* (Dobson, 1871) (Cave Nectar Bat)**

One individual was captured only in Site A on the island. In comparison to past studies, Roslan et al. (2016) also recorded only one individual in Pulau Perhentian Besar while three captures were recorded on the same island previously (Tamblyn et al. 2005). This cave-roosting species occurs in a wide variety of habitat including primary forest (Krau Wildlife Reserve), mangroves, disturbed areas (Pulau Pinang) and plantations (Anwarali et al. 2008; Jayaraj et al. 2016; Francis 2019; William-Dee et al. 2019). As its name suggests, *E. spelaea* is a nectarivorous bat which feeds on nectar and pollen while pollinating a plethora of forest tree species including economically important ones such as durian, petai, and wild banana (Bumrungsri et al. 2013; Stewart & Dudash 2017). *E. spelaea* may roost in rock crevices as Pulau Perhentian Kecil has a hilly terrain with both south and northern region peaks 345m

and 105m above sea level respectively with the latter region consist of rockier terrain (Turner et al. 2003).

Family Rhinolophidae

***Rhinolophus affinis* Horsfield, 1823 (Intermediate Horseshoe Bat)**

A total of 12 individuals were captured in the island with one at Site A and 11 at Site B. The previous study conducted in Pulau Perhentian Kecil, recorded one capture of this species (Tamblyn et al. 2005). As for Pulau Perhentian Besar, the number of *R. affinis* captured were two and seven individuals respectively (Tamblyn et al. 2005; Roslan et al. 2016). A common bat species in Malaysia, this insectivorous bat appears in most localities sampled in Peninsular Malaysia and it mainly roost in caves and forages in forests including dry forest, mature lowland forest and disturbed areas (Naharuddin et al. 2015; Ith et al. 2016; Jayaraj et al. 2016; Lim et al. 2017; Francis 2019).

Family Hipposideridae***Hipposideros cineraceus* Blyth, 1853 (Ashy Roundleaf Bat)**

This species is a new record for Pulau Perhentian Kecil. A total of nine individuals were captured in the island in which four were at site A while five were at site B; however, there were two recorded *H. cineraceus* individuals at Pulau Perhentian Besar (Roslan et al. 2016). This species roost in caves in small to moderately sized colonies, together with other *Hipposideros* bats (Kingston et al. 2009). This species has been found roosting inside culverts; thus, it is safe to assume *H. cineraceus* roost in a tunnel-like structure whether in the hilly forest or rocky terrain in Pulau Perhentian Kecil (Francis 2019).

***Hipposideros dyacorum* Thomas, 1902 (Dayak Roundleaf Bat)**

This species is a new record for the Pulau Perhentian Kecil. One individual of this species was caught only in Site B on the island. On a slightly larger scale, there have been no records of *H. dyacorum* on Pulau Perhentian Besar either. This species is not commonly recorded in Peninsular Malaysia, with only eight recorded localities in the mainland such as Wang Kelian State Park (Jayaraj et al. 2013; Lim et al. 2017). This species roosts in a variety of roosting sites including caves, tree hollows and rock crevices. It mainly forages in the understory portion of the forest (Francis 2019).

***Hipposideros larvatus* (Horsfield, 1823) (Intermediate Roundleaf Bat)**

This species is the third new record of Hipposiderids for Pulau Perhentian Kecil. A total of seven individuals were caught in both of the sampling sites on the island. Six individuals of this species were captured in Pulau Perhentian Besar in recent years (Roslan et al. 2016) while 52 individuals captured in the previous survey (Tamblyn et al. 2005). Another common bat species throughout the nation from Wang Kelian State Park, Perlis, to Bako National Park in Sarawak (Jayaraj et al. 2013), this species mainly roosts in large colonies inside of caves, temples, old mines and rock crevices (Anwarali et al. 2008; Francis 2019; William-Dee et al. 2019). Though usually brown, this species occasionally has bright orange fur due to the effects of cave bleaching (Kingston et al. 2009).

Family Vespertilionidae***Tylonycteris fulvida* (Blyth, 1859) (Mainland Lesser Bamboo Bat)**

This species is a new record in the Perhentian Islands including Pulau Perhentian Besar. One individual was captured only in Site A on the island. Formerly known as *Tylonycteris pachypus*, taxonomic revalidation separates the name as mentioned earlier to Borneo and Sumatra, while *T. fulvida* restricted to mainland Southeast Asia (Tu et al. 2017). As its common name suggests, this species roosts in the internodes of small live bamboo stems (Francis 2019). There are bamboo plots in the west coast of Pulau Perhentian Kecil adjacent to the pathway between Coral Bay and Long Beach (Tamblyn et al. 2005). Although bamboo is the major roost for this species, it had also been observed to roost in small rock crevices and abandoned tree holes (Eguren & McBee 2014).

***Tylonycteris malayana* Chasen, 1940 (Mainland Greater Bamboo Bat)**

This species is a new record for the Perhentian Islands including Pulau Perhentian Besar. One individual was captured only in Site A on the island. Like its smaller cousin, this species formerly called *Tylonycteris robustula* also undergo taxonomic revalidation (Tu et al. 2017). The distribution of *T. malayana* is in mainland Southeast Asia, while *T. robustula* confined to Borneo like in Kubah National Park and Sumatra (Anwarali et al. 2008; Tu et al. 2017). This species also roosts in bamboo internodes, entering through beetle created slits in which they prefer large dead stems (Francis 2019). The presence and abundance of bamboos usually signal a high possibility of this species and *T. fulvida* as in Gunung Stong, Gunung Reng and Gua Musang, Kelantan due to their roosting association with the bamboo plant (Jayaraj et al. 2012b, 2016). Both species regularly change bamboo roosting sites, usually lasting for a short time only (Medway & Marshall 1972).

Family Muridae***Rattus exulans* (Peale, 1848) (Pacific Rat)**

One individual was caught only in Site A on the island. This species is a new confirmed record in the Perhentian Islands (Kecil and Besar). This species is a new confirmed record in Pulau Perhentian Kecil but may have already been recorded by Tamblyn et al. (2005) as the study listed three distinct *Rattus* spp. This species is the smallest among the *Rattus* sp. but tends to be larger on smaller islands (Francis 2019). Although this species is known to occur in anthropogenically modified habitats (cultivated lands, shrublands, and gardens), it can also



be found in forest edges, swamp forest, and limestone areas (Jayaraj et al. 2016; William-Dee et al. 2019).

***Rattus tanezumi* Temminck, 1844 (Asian House Rat)**

A total of three individuals were captured (one was at Site A while two were at Site B). This species is a new confirmed record for Pulau Perhentian Kecil; however, a total of 15 *R. tanezumi* individuals were captured in Pulau Perhentian Besar (Rahim et al. 2016). This species has a generalized diet and is a major pest of plant crops in plantations. This species spends much time on the ground but can also climb well whether on trees or inside buildings (Francis 2019). Although *R. tanezumi* is expected to be confined to anthropogenically modified habitats, there were previous records of this species in rainforests and limestone areas of Borneo and Kelantan. This intrusion may be due to the encroachment of human settlements or plantations, even small ones into the vicinity of natural habitats (Wells et al. 2006; Jayaraj et al. 2016).

***Rattus tiomanicus* (Miller, 1900) (Malaysian Wood Rat)**

A total of four individuals were recorded on the island in which two individuals were caught in both sites respectively. This species is a new confirmed record in Pulau Perhentian Kecil. However, three individuals of *R. tiomanicus* were captured in Pulau Perhentian Besar (Rahim et al. 2016). This species has a widespread distribution on Malaysian islands like Pulau Tenggol, Pulau Pangkor and its namesake, Pulau Tioman (Sen 1971; Pimsai et al. 2014; Jayaraj et al. 2019). This nocturnal species occurs in a wide range of habitats including coastal forests, grasslands, plantations, secondary forests but rarely inside houses. Just like other *Rattus* spp., the diet includes a wide range of animal and plant matter (Jayaraj et al. 2016; Francis 2019).

***Sundamys annandalei* Bonhote, 1903 (Annandale's Rat)**

Previously assigned to the genus *Rattus*, this species has recently undergone a taxonomic revision, placing it in the genus *Sundamys* (Camacho-Sanchez et al. 2017). Two individuals were caught only in Site A on the island. This species is a new confirmed record in the Perhentian Islands (Kecil and Besar). This nocturnal species can be found in rubber plantations and secondary forest, mainly on the lower levels of the tree. Contrary to its appearance, this species is not known to be a significant pest like other rat species (Francis 2019).

DISCUSSION

Notably, the majority of the small mammals recorded in Pulau Perhentian Kecil were bats, conceivably due to the rockier terrain mainly in Site A and presence of an exposed sea cave in Tanjung Kerma near both sampling sites (Turner et al. 2003). While caves are the main roosting site for cave roosting bats, some of them also roost in rocks crevices and hollow trees like *R. affinis*, *H. larvatus*, and *H. dyacorum* (Ith et al. 2015; Francis 2019). As previously stated, Site A has a higher species diversity than Site B even though Site A has lower relative abundance (refer to Table 2). This pattern is possibly due to Site B experiencing a higher degree of human disturbance with tourist trails and small patches of agricultural land. Our study shows that this site is largely dominated by generalist mammal species which can adapt and forage in disturbed habitats such as *T. glis*, *R. affinis*, and *Rattus tanezumi*. Other similar studies reported lower species richness of small mammals when the habitat subjected to human disturbance (Shafie et al. 2011; William-Dee et al. 2019).

To get a clearer picture of the island mammal diversity in Pulau Perhentian Kecil, we have compared our results with the past studies in the Perhentian Islands (Kecil and Besar) and other islands in East Coast Peninsular Malaysia comprising Pulau Bidong, Pulau Redang, Pulau Tioman, and Pulau Tenggol. Past studies in the Perhentian Islands include Campbell et al. (2004) and Roslan et al. (2016) for bats and Rahim et al. (2016) for non-volant small mammals while Tamblyn et al. (2005) and Turner et al. (2003) recorded both bats and non-volant small mammals.

For Pulau Perhentian Kecil, the small mammal species checklist updates with 10 new locality records for *E. spelaea*, *H. cineraceus*, *H. dyacorum*, *H. larvatus*, *T. fulvida*, *T. malayana*, *R. exulans*, *R. tanezumi*, *R. tiomanicus*, and *S. annandalei*. In contrast, the small mammal species checklist only increases with five species (*H. dyacorum*, *T. fulvida*, *T. malayana*, *R. exulans*, and *S. annandalei*) when including Pulau Perhentian Besar data to our study. As the distance between Pulau Perhentian Besar and Pulau Perhentian Kecil is roughly 1.5km (Kampung Nelayan Jetty to Perhentian Besar Ferry Terminal), there is a possibility of species interchange between these two islands. Table 3 shows the small mammal species comparison with other islands in eastern coast Peninsular Malaysia. Incomplete species data in Tamblyn et al. (2005) and Turner et al. (2003) like *Rhinolophus affinis*/*R. stheno*, *Rattus* spp. 1 and *Hipposideros* sp. are not included in the

Table 3. Small mammal species comparison with other islands in east coast Peninsular Malaysia.

	Species	PPK	PPKp	PPB	PB	PR	PTI	PTe
	Erinaceidae							
1	<i>Hylomys suilus</i>	-	-	-	-	-	+	-
	Soricidae							
2	<i>Crocidura fuliginosa</i>	-	-	-	-	+	-	-
3	<i>Crocidura negligens</i>	-	-	-	-	-	+	-
4	<i>Crocidura malayana</i>	-	-	+	-	-	-	-
	Tupaiidae							
5	<i>Tupaia glis</i>	+	+	+	-	+	+	-
	Cynocephalidae							
6	<i>Galeopterus variegatus</i>	-	-	+	-	-	+	-
	Pteropodidae							
7	<i>Cynopterus brachyotis</i>	+	+	+	+	+(1911)	+	+
8	<i>Cynopterus cf. brachyotis</i> Forest	-	-	+	+	-	-	-
9	<i>Cynopterus horsfieldii</i>	-	-	-	-	-	+	-
10	<i>Eonycteris spelaea*</i>	+	-	+	-	+	+	-
11	<i>Pteropus hypomelanus</i>	-	-	+	+	-	+	-
	Emballonuridae							
12	<i>Emballonura monticola</i>	-	-	+	-	+(1911)	+	-
13	<i>Taphazous melanopogon</i>	-	-	+	-	+	-	-
	Nycteridae							
14	<i>Nycteris tragata</i>	-	-	-	-	-	+	-
	Megadermatidae							
15	<i>Megaderma spasma</i>	-	+	+	+	-	+	-
	Rhinolophidae							
16	<i>Rhinolophus affinis</i>	+	+	+	-	+(1911)	+	-
17	<i>Rhinolophus borneensis</i>	-	-	-	-	-	+	-
18	<i>Rhinolophus lepidus</i>	-	-	+	-	-	+	-
19	<i>Rhinolophus luctus morio</i>	-	-	-	-	-	+	-
20	<i>Rhinolophus macrotis</i>	-	-	-	-	-	+	-
21	<i>Rhinolophus megaphyllus</i>	-	-	-	-	-	+(1899–1927)	-
22	<i>Rhinolophus pusillus</i>	-	-	-	-	-	+	-
23	<i>Rhinolophus stheno</i>	-	-	-	-	-	+	-
	Hipposideridae							
24	<i>Aselliscus stoliczkanus</i>	-	-	-	-	-	+	-
25	<i>Hipposideros bicolor</i>	-	+	+	-	-	+(<i>H. kunzi?</i>)	-
26	<i>Hipposideros cineraceus*</i>	+	-	+	-	+	-	-
27	<i>Hipposideros dyacorum**</i>	+	-	-	-	-	-	-
28	<i>Hipposideros larvatus*</i>	+	-	+	-	-	+	-
	Vespertilionidae							
29	<i>Myotis muricola</i>	-	-	+	-	-	-	-
30	<i>Tylonycteris fulvida**</i>	+	-	-	-	-	-	-
31	<i>Tylonycteris malayana**</i>	+	-	-	-	-	-	-
	Molossidae							
32	<i>Cheiromeles torquatus</i>	-	-	-	-	-	+	-



	Species	PPK	PPKp	PPB	PB	PR	PTi	PTe
	Lorisidae							
33	<i>Nycticebus coucang</i>	-	-	-	-	-	+	-
	Cercopithecidae							
34	<i>Macaca fascicularis</i>	-	-	EX	-	+	+	-
35	<i>Trachypithecus obscurus</i>	-	-	+				
	Viverridae							
36	<i>Paradoxurus hermaphroditus</i>	-	-	-	-	-	+	-
	Tragulidae							
37	<i>Tragulus kanchil</i>	-	-	-	-	+	-	-
38	<i>Tragulus napu</i>	-	-	-	-	-	+	-
	Sciuridae							
39	<i>Callosciurus notatus</i>	-	+	+	-	+	+	+
40	<i>Callosciurus nigrovittatus</i>	-	-	-	-	-	+	-
41	<i>Iomys horsfieldii</i>	-	-	-	-	-	+	-
42	<i>Lariscus insignis</i>	-	-	-	-	-	+(1962)	-
43	<i>Petaurista petaurista melanotus</i>	-	-	-	-	-	+	-
44	<i>Ratufa bicolor</i>	-	-	-	-	-	+	-
45	<i>Rhinosciurus laticaudatus</i>	-	-	-	-	-	+(1899-1927)	-
46	<i>Sundasciurus tenuis</i>	-	-	-	-	+	+	-
	Muridae							
47	<i>Leopoldamys sabanus</i>	-	-	-	-	-	+	-
48	<i>Maxomys rajah</i>		-	+	-	-	-	-
49	<i>Maxomys surifer</i>	-	-	+	-	+	+	-
50	<i>Maxomys whiteheadi</i>	-	-	+	-	-	-	-
51	<i>Niniventer cremoriventer</i>	-	-	-	-	-	+(1962)	-
52	<i>Rattus argentiventer</i>	-	+	+	-	-	-	-
53	<i>Rattus exulans**</i>	+	-	-	-	-	-	-
54	<i>Rattus tanezumi*</i>	+	-	+	-	-	+(1962)	-
55	<i>Rattus tiomanicus*</i>	+	-	+	-	+	+	+
56	<i>Sundamys annandalei**</i>	+	-	-	-	-	-	-
57	<i>Sundamys muelleri</i>	-	-	+	-	-	-	-
	Hystricidae							
58	<i>Atherurus macrourus</i>	-	-	-	-	-	+	-
	Total number of species	13	7	25	4	14	41	3

PPK—Pulau Perhentian Kecil (This Study) | PPKp—Pulau Perhentian Kecil past studies (Tamblyn et al. 2005; Campbell et al. 2004) | PPB—Pulau Perhentian Besar (Roslan et al. 2016; Rahim et al. 2016; Tamblyn et al. 2005; Turner et al. 2003) | PB—Pulau Bidong (Roslan et al. 2016) | PR—Pulau Redang (MNS 1990 as cited in Turner et al. 2003) | PTi—Pulau Tioman (Lim BL et al. 1999) | PTe—Pulau Tenggol (Sen 1971) | +—present | -—absent | EX—Extirpated | *—New record from this study in Pulau Perhentian Kecil | **—New record in the islands of East Coast Peninsular Malaysia.

comparison table.

On the other hand, *H. dyacorum*, *T. fulvida*, *T. malayana*, *R. exulans*, and *S. annandalei* are new species locality records for the East Coast islands. *H. dyacorum* is a more common species in Borneo compared in Peninsular Malaysia but has been recorded on the offshore island of Balambangan, Sabah (Benda 2010; Jayaraj et al. 2011).

The nearest locality of this species in the mainland is at Gunung Stong, Kelantan (Lim et al. 2014). Both *T. fulvida* and *T. malayana* are associated with bamboo plants in which many of the localities where they have been found have bamboo plots including our study site in Pulau Perhentian Kecil (Medway & Marshall 1972; Norsham et al. 1999; Sapura 2010; Chooi et al. 2014; Nur

Shahidah 2014; Mohd-Hanif et al. 2015; Lim et al. 2016; Morni et al. 2016).

Furthermore, the Pacific Rat, *R. exulans* is the most prosperous island colonizers among rodents in which this species is ubiquitous in East Coast Peninsular Malaysia and East Malaysia. Due to its smaller size in comparison with other larger rodent species, this species would often opportunistically seek competition-free environments even at primary forests like in Royal Belum (Tamrin et al. 2010; Lim BL 2015). As for *S. annandalei*, its known distribution mainly restricted to West Coast Peninsular Malaysia, eastern Sumatra and Singapore. Although usually found in the mainland, *S. annandalei* can also be found in the islands of Padang and Rupert, Riau. Currently, it is still unclear on why *S. annandalei* has such a restrictive range compared to *Sundamys muelleri* which has an extensive range across southeastern Asia including on Sundaic islands as there are no evident ecological barriers for *S. annandalei* to expand its range (Pimsai et al. 2014; Camacho-Sanchez et al. 2017). Therefore, the capture of this species in Pulau Perhentian Kecil is quite surprising, possibly being the key to answer *Sundamys annandalei* ecological range puzzle. Further sampling in the future is needed to discern whether the two individuals captured in this study were stowaways or an established population of *S. annandalei* thrived on Pulau Perhentian Kecil.

Overall, Pulau Perhentian Besar has a higher number of species (12 for bats and 13 for small non-volant small mammals) compared to Pulau Perhentian Kecil (10 for bats and seven for small non-volant small mammals) probably due to its larger size enabling support of a broader range of niches (Kisel & Barraclough 2010). Despite this, human economic activity may influence the translocation of species, particularly non-volant small mammals across these two islands (Helmus et al. 2014). In comparison with other Malaysian east coast islands, Pulau Tioman amassed the highest number of mammal species at 41 which is not surprising, considering the island is also the largest (13,360ha) and has extensive flora and fauna surveys conducted since 1899 (Lim et al. 1999). While Pulau Redang is bigger than both Perhentian Islands combined at 1909ha, the lower number of mammal species recorded in this island is probably due to undersampling efforts, hence this island requires an updated mammal species checklist. The same goes to Pulau Bidong and Pulau Tenggol which has no published small mammal diversity records.

CONCLUSION

This short study managed to record 10 new species locality records of small mammals in Pulau Perhentian Kecil, with five are new records for Malaysian east coast islands indicating that there is much to research and document on island fauna particularly on mammalian species diversity in the future. Pulau Perhentian Kecil is not only rich in marine biodiversity but also plentiful in terrestrial wildlife for its small size. Therefore, it is paramount that this area is not only protected for its island flora and fauna but there is also a need to conduct sustainable tourism practices in order to preserve the beauty of these islands.

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- Malay abstract:** Pulau secara amnya, kaya dengan biodiversiti hidupan laut, tetapi juga menyembunyikan hidupan liar unik dan endemik di daratan. Maklumat berkaitan hidupan liar di pulau-pulau yang terdapat di Malaysia terutamanya pulau-pulau kecil masih kekurangan. Oleh itu, kajian telah dilaksanakan untuk membuat inventori kepelbagaian mamalia kecil (terbang & bukan terbang) di Pulau Perhentian Kecil. Pulau ini merupakan sebuah destinasi pelancongan yang terkenal dengan pelbagai jenis hidupan laut yang mengagumkan dan pantai berpasir yang indah. Meskipun pulau ini merupakan lokasi tumpuan pelancong, informasi yang diketahui mengenai kepelbagaian fauna di pulau ini amat terhad dibandingkan dengan jirannya yang lebih besar, Pulau Perhentian Besar. Survei yang telah dilaksanakan pada 21 hingga 30 Mei 2014 berjaya mencatat 56 individu haiwan merangkumi lapan spesies kelawar dan lima spesies mamalia kecil bukan terbang yang ditangkap dengan jaring burung, perangkap kelawar (*Harp trap*) dan perangkap sangkar tikus. Survei ini telah mencatatkan 10 rekod spesies tambahan bagi pulau ini berbanding laporan sebelum ini. Lima spesies daripada rekod tambahan ini belum pernah dijumpai di Pulau Perhentian Besar. Penemuan spesies *Hipposideros dyacorum*, *Tylonycteris fulvida*, *T. malayana*, *Rattus exulans* dan *Sundamys annandalei* di Pulau Perhentian Kecil juga merupakan rekod taburan baharu yang belum pernah di laporkan di mana-mana pulau di Pantai Timur Semenanjung Malaysia. Penemuan ini secara tidak langsung mengangkat kepentingan melindungi biodiversiti pulau yang penuh dengan keunikan. Diharap hasil kajian ini dapat digunakan dalam merancang pengurusan pelancongan di pulau ini untuk pembangunan secara lestari di samping menguruskan kawasan ekologi yang sensitif ini.
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- Author contributions:** JVK is the principal investigator and was also involved in the field work and manuscript preparation. AB, BRN, CJL & FAAK prepared the draft manuscript for the publication. IA & EWC were involved in the field work.
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Appendix 1. Data set - Bats

Field No.	Date	Genus	Species	State	Locality	Sex	Age	FA	E	TB	HF	T	TL	WT	Liver	Muscle	Small Intestine	Notes
PP14-001	21/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	49.01	19.43	23.25	1.134	28.53	79.36	13.00	1	1	1	
PP14-002	21/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	55.74	18.01	23.74	1.100	28.64	94.70	16.00	1	1	1	
PP14-003	21/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	41.84	17.37	20.17	8.30	27.88	81.06	8.00	1	1	1	
PP14-005	22/05/14	<i>Eonycteris</i>	<i>spelaea</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	67.93	20.48	31.26	14.55	11.36	116.36	44.00	1	1	1	
PP14-006	22/05/14	<i>Cynopterus</i>	<i>brachyotis</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	57.91	18.41	21.29	13.05	10.47	90.47	20.00	1	1	1	
PP14-008	22/05/14	<i>Cynopterus</i>	<i>brachyotis</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	59.70	18.03	22.47	13.69	8.97	88.97	22.00	1	1	1	
PP14-009	22/05/14	<i>Tylonycteris</i>	<i>pachypus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	25.22	10.15	11.52	4.95	27.00	92.00	5.00	1	1	1	
PP14-011	22/05/14	<i>Tylonycteris</i>	<i>robustula</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	26.50	10.94	11.99	5.05	30.00	75.00	4.50	1	1	1	
PP14-019	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	44.00	19.00	19.00	8.00	28.00	78.00	6.00	1	1	1	
PP14-020	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	44.00	20.00	19.00	9.00	28.00	76.00	6.00	1	1	1	
PP14-021	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	43.00	20.00	18.00	8.00	30.00	81.00	6.00	1	1	1	
PP14-022	23/05/14	<i>Hipposideros</i>	<i>dyacorum</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	45.00	19.00	17.00	8.00	21.00	72.00	6.00	1	1	1	
PP14-024	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	57.00	23.00	22.00	11.00	31.00	99.00	15.00	1	1	1	
PP14-025	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	53.00	23.00	26.00	11.00	24.00	88.00	12.00	1	1	1	
PP14-027	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	57.00	21.00	23.00	11.00	32.00	95.00	13.00	1	1	1	
PP14-028	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	57.00	21.00	22.00	11.00	32.00	96.00	15.00	1	1	1	
PP14-029	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	51.00	22.00	24.00	11.00	22.00	88.00	12.00	1	1	1	
PP14-030	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	44.00	20.00	19.00	9.00	27.00	80.00	7.00	1	1	1	
PP14-031	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	51.00	23.00	25.00	13.00	23.00	85.00	11.00	1	1	1	
PP14-032	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	51.00	22.00	24.00	12.00	22.00	85.00	12.00	1	1	1	
PP14-033	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.00	23.00	24.00	12.00	22.00	82.00	11.00	1	1	1	
PP14-034	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.00	23.00	24.00	13.00	22.00	85.00	10.00	1	1	1	
PP14-035	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.00	22.00	24.00	12.00	22.00	82.00	11.00	1	1	1	
PP14-037	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.00	22.00	24.00	12.00	22.00	82.00	10.00	1	1	1	
PP14-038	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.86	18.52	24.34	9.24	23.12	23.12	12.00	1	1	1	Released
PP14-039	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	44.82	15.87	21.16	8.29	31.87	31.87	7.50	1	1	1	Released
PP14-040	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	51.13	19.15	25.48	7.02	22.75	22.75	13.00	1	1	1	
PP14-041	23/05/14	<i>Rhinolophus</i>	<i>affinis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	50.42	20.85	23.29	11.30	23.09	23.09	12.50	1	1	1	
PP14-042	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	44.11	15.04	19.34	6.22	28.86	28.86	8.50	1	1	1	Released
PP14-043	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	43.81	14.42	18.58	6.46	26.89	26.89	7.00	1	1	1	

Field No.	Date	Genus	Species	State	Locality	Sex	Age	FA	E	TB	HF	T	TL	WT	Liver	Muscle	Small intestine	Notes
PP14-044	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	55.25	15.55	21.10	9.07	26.65	26.65	17.50	1	1	1	Released
PP14-045	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	56.99	15.16	25.63	8.03	28.11	28.11	16.00	1	1	1	Released
PP14-046	23/05/14	<i>Hipposideros</i>	<i>cineraceus</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	43.88	15.77	19.89	7.11	29.15	29.15	8.50	1	1	1	Released
PP14-047	23/05/14	<i>Hipposideros</i>	<i>larvatus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	58.58	12.99	22.96	8.86	31.22	31.22	43.00	1	1	1	Released

E—Ear | FA—Forearm | HF—Hindfoot | TB—Tibia | T—Tail | TL—Total length (head to tail) | WT—Weight.

Appendix 2. Data set - Rodents and Scandentia

Field No.	Date	Genus	Species	State	Locality	Sex	Age	E	HF	HB	T	TL	WT	Liver	Muscle	Small intestine	Skin
PP14-004	22/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	17.00	45.00	180.00	189.00	369.00	150.00	1	1	1	1
PP14-007	22/05/14	<i>Rattus</i>	<i>rattus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	21.00	35.00	174.00	191.00	365.00	105.00	1	1	1	1
PP14-010	22/05/14	<i>Rattus</i>	<i>tiomanicus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	21.00	38.00	170.00	190.00	360.00	100.00	1	1	1	1
PP14-012	22/05/14	<i>Rattus</i>	<i>annandalei</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	22.00	36.00	177.00	194.00	371.00	155.00	1	1	1	1
PP14-013	22/05/14	<i>Rattus</i>	<i>tiomanicus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	20.00	31.00	120.00	145.00	265.00	47.00	1	1	1	1
PP14-014	22/05/14	<i>Rattus</i>	<i>rattus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	21.00	32.00	160.00	186.00	346.00	90.00	1	1	1	1
PP14-015	22/05/14	<i>Rattus</i>	<i>tiomanicus</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	20.00	33.00	155.00	181.00	336.00	85.00	1	1	1	1
PP14-016	22/05/14	<i>Rattus</i>	<i>exulans</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	19.00	32.00	125.00	139.00	264.00	44.00	1	1	1	1
PP14-017	22/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	16.00	46.00	189.00	145.00	334.00	135.00	1	1	1	1
PP14-018	22/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	21.00	47.00	179.00	190.00	369.00	150.00	1	1	1	1
PP14-023	23/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	17.00	45.00	186.00	167.00	353.00	170.00	1	1	1	1
PP14-026	23/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	11.00	44.00	185.00	187.00	372.00	135.00	1	1	1	1
PP14-048	23/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	16.00	45.00	177.00	197.00	374.00	125.00	1	1	1	1
PP14-049	23/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	17.00	48.00	184.00	203.00	387.00	135.00	1	1	1	1
PP14-050	23/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	F	Adult	18.00	48.00	193.00	191.00	384.00	180.00	1	1	1	1
PP14-051	24/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site B	M	Adult	15.00	47.00	193.00	163.00	356.00	140.00	1	1	1	1
PP14-052	25/05/14	<i>Rattus</i>	<i>tiomanicus</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	21.00	36.00	164.00	187.00	351.00	125.00	1	1	1	1
PP14-053	26/05/14	<i>Rattus</i>	<i>rattus</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	22.50	37.00	184.00	213.00	397.00	145.00	1	1	1	1
PP14-054	27/05/14	<i>Rattus</i>	<i>annandalei</i>	Terengganu	Pulau Perhentian, Site A	M	Adult	23.00	37.00	190.00	202.00	392.00	145.00	1	1	1	1
PP14-055	28/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	16.00	46.00	178.00	190.00	368.00	120.00	1	1	1	1
PP14-056	29/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	16.00	46.00	195.00	180.00	375.00	125.00	1	1	1	1
PP14-057	30/05/14	<i>Tupaia</i>	<i>glis</i>	Terengganu	Pulau Perhentian, Site A	F	Adult	17.00	47.00	193.00	220.00	413.00	185.00	1	1	1	1

E—Ear | HF—Hindfoot | HB—Head to Body | T—Tail | TL—Total length (head to tail) | WT—Weight.





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Conservation Application

First attempt at rehabilitation of Asiatic Black Bear cubs to the wild in Thailand

– Robert Steinmetz, Worrapan Phumane, Rungnapa Phoonjampa & Suthon Weingdow, Pp. 18411–18418

Communications

Status of Sumatran Tiger in the Berbak-Sembilang landscape (2020)

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