The Mammals of the Southern Islands of Singapore

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ABSTRACT. Terrestrial and marine mammals were investigated as part of the Southern Islands Biodiversity Survey (2020–2022), covering islands, reefs and sea channels south of Singapore. 25 species were recorded, about a quarter of Singapore's mammal fauna, but only one island had more than eight species: Pulau Sentosa (a large, inshore, well vegetated and well surveyed island) had 21. Ten species were bats, and all but a few species had evident means of dispersal by flight, swimming or as commensals of man.

Keywords. Conservation, island fauna, Mammalia, tropics

Introduction

The mammalian fauna of Peninsular Malaysia consists of approximately 215 species (Medway, 1978), and of these the 83 species recorded in Singapore (Baker & Lim, 2012) are a sub-set. Large mammals were historically present in Singapore, including top predators such as tigers *Panthera tigris* and leopards *P. pardus* (e.g., Omar, 2020), and still today there are occasional records of individual Asian elephants *Elephas maximus* and Malayan tapirs *Tapirus indicus*, displaced from Malaysia, reaching Singapore or its offshore islands (Saini, 1990; Miller, 1991; Woon, 2023). Such occasional records illustrate the capacity of some mammals to cross short sea barriers, but the establishment of sustained breeding populations is reduced or prevented by small land area, habitat suitability, infrastructure, traffic and human populations in modern Singapore (Tan et al., 2010).

The sea distances between 'mainland' Singapore and its offshore Southern Islands are up to one order of magnitude greater than the distance between southernmost Peninsular Malaysia and Singapore, in the order of 0.3 to 10 km (see maps in Tan et al.,2025). Compared to mainland Singapore with a land area of approximately 647 km^2, the biggest of the unreclaimed Southern Islands is only 4.8 km^2 and all 16 island locations covered in the present study total only 12 to 13 km^2 (Tan et al., 2025). Jurong Island is bigger, about 32 km^2, but it results from the agglomeration of several smaller islands, is fully industrialised, and not accessible for study. Barriers to mammal arrivals on the Southern Islands are therefore a little greater, and constraints on population establishment through area of habitat are much greater than on mainland Singapore.

Citizen science groups have recorded mammals on some of the Southern Islands (e.g., Baker & Lim, 2012), pre- or post-development surveys have identified some mammals (e.g., Yeo, 2016), and there are scattered records of marine mammals as well (e.g., Lee & Ooi, 2020; Ng et al., 2022). No comprehensive listing exists as a basis for description of the whole Southern Islands mammal community nor for comparison between individual islands. Therefore, mammals were included as one component of the Southern Islands Biodiversity Study (SIBS) conducted by the National Parks Board (Tan et al., 2025).

Materials and Methods

Terrestrial fauna surveys were conducted 33 times between February 2020 and March 2022 (Tan et al., 2025, Table 1). These included visual surveys conducted during the day as well as nocturnal surveys. The eight sites surveyed included Pulau Brani, Pulau Hantu, Pulau Tembakul (Kusu Island), Pulau Sekijang Pelepah (Lazarus Island), Pulau Sekijang Bendera (St John's Island), Pulau Semakau, Pulau Blakang Mati (Sentosa), and Pulau Tekukor. Three camera traps were deployed on Pulau Sentosa (at Bukit Serapong) in Feb–Mar 2020, on Pulau Tekukor in Mar–May 2020 and on Pulau Semakau in Dec 2020–Feb 2021. They were installed at a height of 30cm above the ground. Although Pulau Biola (0.7ha), Keppel (5.4ha), Pulau Salu (1.0ha) and Pulau Satumu (1.2ha) were visited several times, no mammals were detected there so these four islands are not included in the results.

A review of published and unpublished mammalian records from the Southern Islands was undertaken, and records were included in the SIBS fauna database. The earliest literature consulted dated to 1995, and the latest dated to 2022, with the full reference details tagged in the database. These records added Pulau Jong and the two Sisters' Islands (considered as one site) to the list of localities, bringing the total number of sites to ten (14 if the zero scores from Pulau Biola, Salu, Satumu and Keppel are included) for terrestrial mammals and adding Cyrene Reef for marine mammals.

Basic topographical data on each island and reef (area, maximum elevation, length of coastline) are given by Tan et al. (2025). Miscellaneous information about past settlements and land use of each island is given by Muzaini et al. (2025).

Results

There were records of 22 species of terrestrial wild mammals plus domestic dogs and cats (Appendix 1), and records of three marine mammals (Appendix 2). Among the terrestrial species were ten bats (45% of terrestrial species). They include two species of flying foxes *Pteropus* spp., both pertaining to old records from Sentosa dated 1995 and 2009, compiled one or two decades later by EnviroPro (2018). Malayan Flying Fox *P. vampyrus* occurred in large numbers on mainland Singapore in the 19th century and still occurs as a long-distance vagrant, and there is no particular reason to doubt the past occurrence of the small-island specialist Island Flying Fox *P. hypomelanus*, although neither species was listed by Baker & Lim (2012). Without access to original notes, it is now impossible to be sure of the identity of the two Sentosa records, but there is clearly no current viable population of either on the Southern Islands. The most widely distributed bat was the Lesser Dog-faced Fruit-bat *Cynopterus brachyotis* (on six out of ten islands) followed by the Pouched Tomb-bat *Saccolaimus saccolaimus* (on three islands). Presumably all the bats listed have the potential to move from island to island, and it is likely that bats were under-recorded.

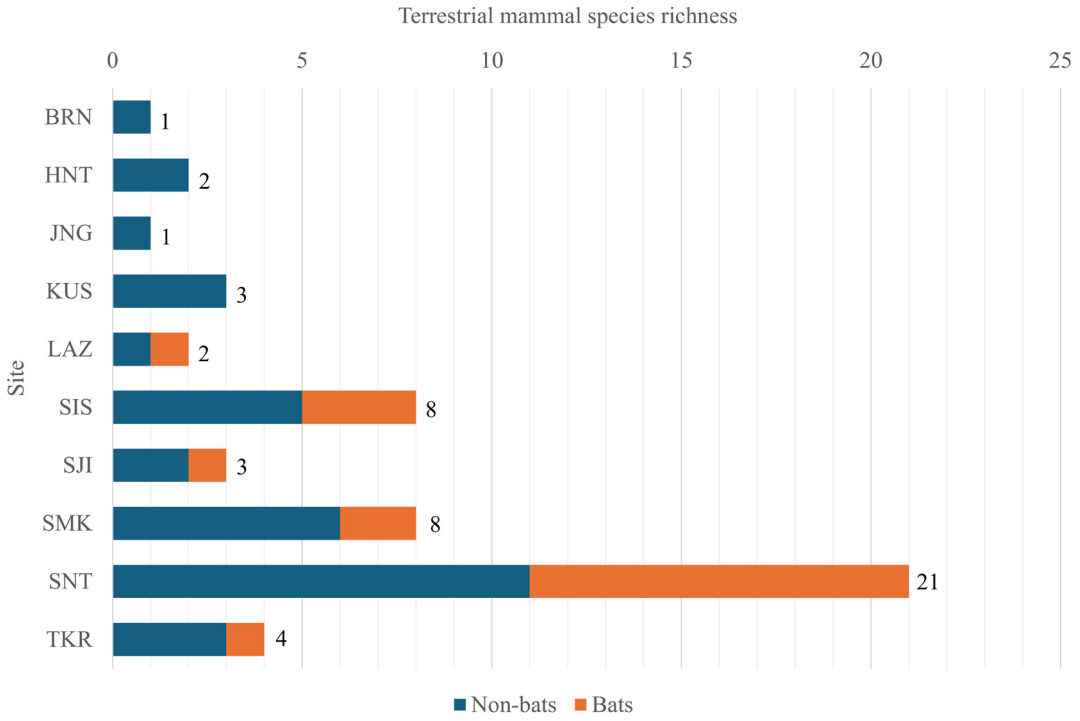


Figure 1. Recorded terrestrial mammal species richness of the Southern Islands, Singapore by site. BRN = Pulau Brani, HNT = Pulau Hantu, JNG = Pulau Jong, KUS = Pulau Tembakul (Kusu Island), LAZ = Pulau Sekijang Pelepah (Lazarus Island), SIS = Pulau Subar Laut and Pulau Subar Darat (Sisters' Islands), SJI = Pulau Sekijang Bendera (St John's Island), SMK = Pulau Semakau, SNT = Pulau Blakang Mati (Sentosa Island), TKR = Pulau Tekukor.

Marine mammals were also under-recorded and there is little value in attributing records to particular islands. There were no records of Indo-Pacific Bottlenose Dolphin *Tursiops aduncus* and only a handful of records of Indo-Pacific Humpback Dolphin *Sousa chinensis* (Appendix 2), although the former has often been seen for limited periods under particular fishing conditions associating with small boats. No marine mammals were detected near the wholly intertidal habitat of Pulau Berkas and Terumbu Pempang.

Of the 25 wild species both terrestrial and marine, three are considered to be Critically Endangered in Singapore, including the Naked Bat *Cheiromeles torquatus*, the Malayan Flying Fox (*Pteropus vampyrus*) and the Indo-Pacific Humpback Dolphin (Davison et al., 2024). One species, the Smooth-coated Otter (*Lutrogale perspicillata*), is listed as Endangered in Singapore, and one is listed as Vulnerable, the Greater Bamboo Bat (*Tylonycteris malayana*). Fifteen are listed as being of Least Concern (Appendix 1 and 2).

Terrestrial mammals were recorded across ten out of 12 survey sites. Pulau Blakang Mati (Sentosa) had the highest species richness for mammals, with 21 wild mammal species. Only three of these were recorded by SIBS fieldwork, eight were compiled from reports during the SIBS period (2019–2022), and ten only from records in the period 1995–2018. Pulau Semakau (SMK) had eight terrestrial mammals recorded, as did the two Sisters' Islands (Pulau Subar Laut and Pulau Subar Darat, SIS). Seven sites each had one to four terrestrial mammals, and four sites had none (Pulau Biola, Salu, Satumu and Keppel). Pulau Berkas, Cyrene Reef and Terumbu Pempang lacked any terrestrial habitat.

Discussion

Of some 83 mammal species recorded in Singapore (Baker & Lim, 2012), only 22 terrestrial and three marine species were found in the Southern Islands offshore from mainland Singapore (Appendix 1 and 2). One or two others are known to occur in the vicinity without attribution to any particular island, e.g., Indo-Pacific Bottlenose Dolphin (Davison et al., 2024). These illustrate various points about survey methods as well as dispersal capabilities of individual mammals.

The mammal with the widest recorded distribution across sites was the Smooth-coated Otter *Lutrogale perspicillata* which was observed across seven sites. Interestingly, the first record (1938) of this species for Singapore was in fact on one of the Southern Islands: Pulau Sekijang Pelepah (Lazarus Island). Despite anecdotal reports by fish farmers in the 1960s of their presence along the northwest coast of mainland Singapore, it was only in 1990 that the next confirmed sighting was made at Sungei Buloh (Sivasothi & Nor, 1994). These are large, mobile animals travelling in family groups, highly adapted to coastal and inland waters, and evidently have no difficulty moving to and between near-shore islands. They are known to travel readily between mainland Peninsular Malaysia, mainland Singapore and Pulau Ubin, comparable distances to those between the Southern Islands. After several decades of absence from Singapore, presumably because of past human development and disturbance, Smooth-coated Otters have increased dramatically over the past two decades. This is true for the Southern Islands as well; while recent sightings were initially limited to lone individuals such as at Pulau Semakau (Chua, 2011), large family groups (>5) are now often seen on the larger islands near the mainland such as Sentosa as well as smaller, isolated islands such as the Sisters' Islands.

Wild Boar *Sus scrofa* have also increased dramatically in mainland Singapore after an absence of many decades. It is presumed though unproven that they arrived from Peninsular Malaysia via Pulau Ubin to mainland Singapore. They are known to swim well so they can make narrow sea crossings. The only record in the Southern Islands was from Pulau Semakau, neither the largest nor the closest to mainland Singapore, recorded by camera trap. Former residents of the island who moved out in the 1980s mentioned (pers. comm. to YHJT) that wild boars were not present then, but were found on Pulau Senang several kilometres away. It is unknown if the most recent sighting is descended from this former population or elsewhere.

More widely observed mammals included the Oriental House Rat *Rattus tanezumi*, Long-tailed Macaque *Macaca fascicularis* and the Lesser Dog-faced Fruit-bat *Cynopterus brachyotis*, each recorded at six sites but not the same six in each case. Rats frequently spread with humans as an opportunistic commensal, macaques swim in fresh and coastal areas but can also be carried deliberately by people, and fruit-bats can readily fly several kilometres. Macaques can be deliberately released (e.g., if pets become troublesome) and can survive on small islands (e.g., Pulau Hantu) and islands without freshwater sources (e.g., Pulau Tekukor) by obtaining moisture from plants (pers. obs., YHJT). Further commensals include Asian House-mouse *Mus castaneus*, introduced Brown Rat *Rattus norvegicus*, and House Shrew *Suncus murinus*.

Setting aside those species with obvious dispersal capabilities either by swimming, hitch-hiking or flying, the mammalian fauna of the Southern Islands is highly depauperate. At most, only four or five of the total species listed have less obvious dispersal capabilities (three rats, a squirrel, a civet), but any of them could have been carried accidentally or

deliberately by people. Each of them occurs on only one to four islands, of which Sentosa – with the largest area of semi-natural vegetation but also the greatest human development, close to mainland Singapore and connected by a multi-lane road bridge – is always one. The Common Palm Civet *Paradoxus musangus* was surprisingly caught on a camera trap at Pulau Subar Laut (Big Sisters' Island) during the survey. The distance between Sisters' Islands and Sentosa (the only other island it was recorded on) is substantial, and it is unclear if this individual managed to swim over or perhaps hitch-hiked on a boat that visited the island, possibly as a released pet.

While some of the terrestrial mammal species have national conservation significance, their Southern Islands populations are not key to their conservation in Singapore, except conceivably for the Naked Bat. The opposite is true of the marine mammals: national records of the Indo-Pacific Humpback Dolphin, Dugong and (not recorded in this survey) Indo-Pacific Bottlenose Dolphin are concentrated round the Southern Islands and the adjacent Singapore Straits. Ng et al. (2022) reported a sighting of live Dugong in 2020 at Sentosa, and dead Dugongs at Pulau Hantu and Sisters' Islands in 2021. Dugong feeding trails have often been seen at Cyrene Reef and Pulau Semakau by one of the authors (YHJT) and by citizen scientists. Ng et al. (2022) noted that the east Johor Straits are the stronghold of Dugong in Singapore's waters, but the continued presence of physical sightings and feeding trails suggest that they also persist in the Southern Islands. Dugong feeding trails have also been seen along East Coast Park and Changi Bay (pers obs, YHJT), which could act as stepping stones for movement between the east Johor Straits and the Southern Islands. Indo-Pacific Humpback Dolphins were seen near St John's, Lazarus, and Pulau Semakau. They likely use the whole Singapore Straits and have often been seen near Jurong Island (Lee & Ooi, 2020).

Concerning survey methods, not every island could be surveyed equally. Examples of survey intensity include 18 surveys on Pulau Sentosa (one per 27 ha) and two surveys on Keppel Island (one per 2.7 ha). Islands differed in accessibility to be surveyed, and in accessibility at night. Lack of access to some islands means that coverage could not be complete. Traps, nets and camera traps could not be deployed equally on the islands that were surveyed. Surveys were brief, a few hours each, so rare occurrences of vagile mammals such as bats or marine mammals were unlikely to be recorded. Lastly, the results recorded only presence, not abundance or likelihood of viable populations.

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Appendix 1 Locations of recorded terrestrial mammal species from published and unpublished literature and Southern Islands Biodiversity Survey (SIBS) data. Abbreviations of island names follow the list given in caption of Figure 1. SIBS indicates taxa observed during Southern Islands Biodiversity Survey 2019–2022. Year corresponds to most recent publication or NParks internal record of respective mammal taxon. RDB3 = Singapore Red Data Book 3 national conservation status, IUCN = International Union for Conservation of Nature global conservation status. Acronyms for RDB3/IUCN: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, NE = Not Evaluated, NA = Not Applicable, NL = Not Listed.

Family	Scientific name	RDB3	IUCN	BRN	HNT	JNG	KUS	LAZ	SIS	SJI	SMK	SNT	TKR
Canidae	*Canis lupus familiaris*	NA Feral	NL									2020	
Cercopithecidae	*Macaca fascicularis*	LC	EN		SIBS		SIBS		2019	SIBS		2020	SIBS
Emballonuridae	*Saccolaimus saccolaimus*	LC	LC						2018		2012	2020	
Emballonuridae	*Taphozous melanopogon*	LC	LC									2020	
Felidae	*Felis catus*	NA Feral	NL					SIBS		SIBS	2012	2020	
Molossidae	*Cheiromeles torquatus*	CR	LC									2020	
Muridae	*Mus castaneus*	NA	NL									2009	
Muridae	*Sundamys annandalei*	LC	LC									2018	
Muridae	*Rattus exulans*	LC	LC									2018	
Muridae	*Rattus norvegicus*	NA	LC									2009	
Muridae	*Rattus tanezumi* (1)	LC	LC		2004	2004	2004		2019		2012	2009	
Muridae	*Rattus tiomanicus*	LC	LC								2012	2018	
Mustelidae	*Lutrogale perspicillata*	EN	VU				(2)	(2)	2019	(3)	2012	2018	(2)
Pteropodidae	*Cynopterus brachyotis*	LC	LC					SIBS	2019	SIBS	2012	SIBS; 2020	SIBS
Pteropodidae	*Pteropus hypomelanus*	NL	NT									2009	
Pteropodidae	*Pteropus vampyrus*	CR	NT									1995	
Sciuridae	*Callosciurus notatus*	LC	NE	SIBS							(4)	SIBS; 2020	
Soricidae	*Suncus murinus*	LC	LC						2019		2012	2020	SIBS
Suidae	*Sus scrofa*	LC	LC								SIBS		
Vespertilionidae	*Myotis muricola*	LC	LC									SIBS; 2020	

Appendix 1. Continuation.

Family	Scientific name	RDB3	IUCN	BRN	HNT	JNG	KUS	LAZ	SIS	SJI	SMK	SNT	TKR
Vespertilionidae	*Pipistrellus javanicus*	LC	LC									2020	
Vespertilionidae	*Scotophilus kuhlii*	LC	LC						2018			2020	
Vespertilionidae	*Tylonycteris malayana*	VU	LC									2009	
Viverridae	*Paradoxurus musangus*	LC	LC						(2)			2020	

(1) records before 2008 were listed under the name *Rattus rattus*; (2) = (pers. obs.), (3) = personal communication within the SIBS survey period 2019-2022, (4) = Yeo (2016: Singapore Biodiversity Records)

Appendix 2. Locations of recorded marine mammal species from published and unpublished literature and Southern Islands Biodiversity Survey (SIBS) data. Abbreviations of island names follow listing in caption of Figure 1. SIBS indicates taxa observed during Southern Islands Biodiversity Survey 2019–2022. Year corresponds to most recent publication or NParks internal record of the respective taxon. RDB3 = Singapore Red Data Book 3 national conservation status, IUCN = International Union for Conservation of Nature global conservation status. Acronyms for RDB3/IUCN: NE = Not evaluated, CR = Critically Endangered, EN = Endangered, VU = Vulnerable.

Family	Scientific name	RDB3	IUCN	BRN	CYR	HNT	JNG	KUS	LAZ	SIS	SJI	SMK	SNT	TKR
Delphinidae	*Sousa chinensis*	CR	VU						2014; (3)		2017	2012		
Dugongidae	*Dugong dugon*	CR	VU		(2)	2022				2022		(2)	2022	

(2) = suspected tracks (pers. obs.) within the SIBS survey period 2019-2022, (3) = personal communication within 2019- 2022



Appendix 3. (A) Common palm civet (*Paradoxurus musangus*) at Sisters' Islands. **(B)** Lesser Dog-faced Fruit Bat at Sentosa, credit: Jonathan Tan. **(C)** Family of Indo-Pacific Humpback Dolphins (*Sousa chinensis*) including one calf, St. John's Island, credit: Jonathan Tan.