Reptiles and Amphibians of the Southern Islands of Singapore

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ABSTRACT. Terrestrial and semi-terrestrial reptiles (29 species), marine reptiles (three species) and amphibians (ten species) were recorded as part of the Southern Islands Biodiversity Survey, Singapore. Many of the terrestrial reptiles and amphibians are commensal with humans or opportunistic colonisers of man-made habitats. Most species are likely to have reached the islands through accidental introduction, but those arriving naturally include reptiles with strong swimming abilities. Terrestrial reptiles on the islands are dominated by snakes, opening questions about their likely diets in the face of low prey diversity.

Keywords. Conservation, island fauna, Amphibia, Reptilia, Tropics

Introduction

Herpetology is the study of amphibians and reptiles. Yet the anatomy, physiology, diets, behaviour and reproductive characteristics of amphibians and of reptiles are so distinct that their challenges in reaching and colonising small islands are extremely different. In particular, the moist naked skin of amphibians challenges their movement across saltwater barriers and the diversity of amphibians on offshore islands is typically low.

Furthermore, census methods for amphibians and reptiles are difficult to standardise especially for nocturnal, diurnal, aquatic, semi-aquatic, fossorial, arboreal or sometimes venomous taxa. Checklists may take years of effort to compile, and new records are sometimes discovered after decades or longer. Herpetofauna in Singapore although comparatively well studied when compared to other parts of the region, still there remains an abundance of discoveries and rediscoveries, and new taxa described in recent decades (Grismer et al., 2012; 2017; Baker, 2014; Figueroa & Law, 2021; Law et al., 2019; Law et al., 2020; Serin et al., 2017; Sankar et al., 2022, Chantong et al., 2024) that suggest that more remain to be explored. None of the Southern Islands have previously had published checklists of herpetofauna, with the exception being Pulau Semakau (Chua, 2011); but scattered records for many islands do exist. This study provides the first comprehensive herpetofauna checklist for the Southern Islands, based on literature and unpublished records, as well as field surveys.

In helping to fulfil data requirements for conserving the biodiversity of Singapore, amphibians and reptiles were surveyed as part of the Southern Islands Biodiversity Survey (Tan et al., 2025).

Materials and Methods

Reptiles and amphibians were recorded in 33 terrestrial surveys during the Southern Islands Biodiversity Survey (SIBS), Singapore, between February 2020 and March 2022 (Tan et al., 2025, Table 1). This was done through visual surveys conducted during the day and at night, with. The eight island sites surveyed were Pulau Brani, Pulau Hantu, Pulau Tembakul (Kusu

Island), Pulau Sakijang Pelepah (Lazarus Island), Pulau Sakijang Bendera (St John's Island), Pulau Semakau, Sentosa (formerly Pulau Blakang Mati), and Pulau Tekukor. Although Pulau Salu (1.0 ha) was visited, no reptiles were detected there so the island is not included in the tables of results. Reptiles were identified and photographed at their respective locations, and the recorded species were added to the SIBS fauna database.

A review of published and unpublished reptile and amphibian records from the Southern Islands was undertaken, and records were included in the SIBS fauna database. These included both terrestrial and marine taxa. The earliest literature consulted dated to 1995, and the latest dated to 2020, with the full reference details tagged in the database. The past records, as well as incidental records collected during the SIBS period (2020–2022) but outside the formal surveys, added a further eight reefs or islands to the list of localities (Pulau Biola, Pulau Berkas, Pulau Jong, Keppel Island, Pulau Satumu, Sisters' Islands, Cyrene Reef and Terumbu Pempang) bringing the total number of sites to 16 (17 if the negative result of Pulau Salu is included).

Results

The list of 33 reptile species included 29 terrestrial species (Table 1) that are represented in Singapore territory. These included native (27) or introduced (two) populations, one escaped exotic (*Melanosuchus niger*), and three native wholly marine reptiles (Table 2). Terrestrial or partly terrestrial reptiles were found at 15 sites, but not at the three reefs (Pulau Berkas, Terumbu Pandan (Cyrene Reef), Terumbu Pempang), or Pulau Biola (Table 1). Pulau Blakang Mati (Sentosa) had the highest species richness for terrestrial or partly terrestrial reptiles, with 25 species recorded plus the single escaped exotic. Of those 25, ten species were not found on any other of the Southern Islands.

Thirteen of the 27 native species of terrestrial or partly terrestrial reptiles were each recorded from a single locality. Only three species were recorded from more than five localities each, these being the Malayan Water Monitor *Varanus salvator* (ten sites), Common House Gecko *Hemidactylus frenatus* (eight sites) and Reticulated Python *Malayopython reticulatus* (eight sites).

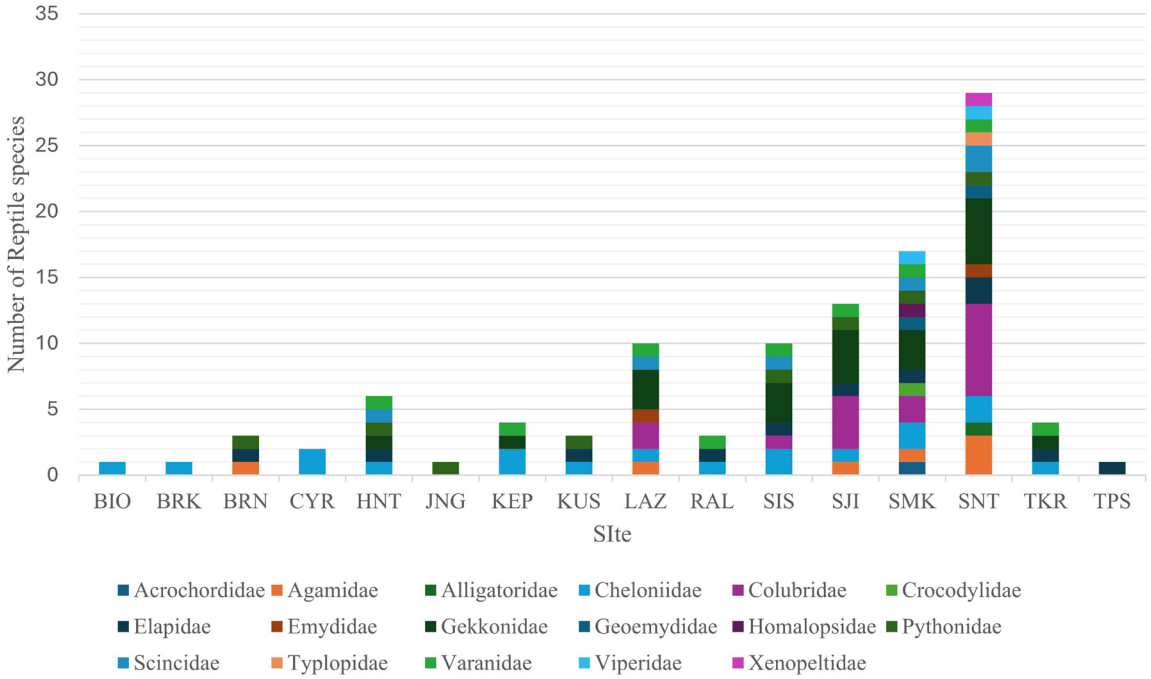


Figure 1. Recorded reptile species richness of the Southern Islands, Singapore by site. BRN = Pulau Brani, HNT = Pulau Hantu, JNG = Pulau Jong, KUS = Pulau Tembakul (Kusu Island), LAZ = Pulau Sakijang Pelepah (Lazarus Island), SIS = Pulau Subar Laut and Pulau Subar Darat (Sisters' Islands), SJI = Pulau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

The terrestrial or partly terrestrial reptile fauna was dominated by snakes (15 native species) and lizards (ten natives plus one introduced, *Calotes versicolor*), with one native (*Cuora couro*) and one introduced chelonian (*Trachemys scripta*), and one crocodilian. Three species of marine reptiles were recorded, comprising two chelonians and one snake.

Ten or possibly 11 species of amphibians have been recorded in the Southern Islands, the uncertainty relating to difficult identification of the very small *Microhyla* species. Amphibians were only recorded on four of the larger islands: Lazarus (Pulau Sakijang Pelepah), Saint John's (Pulau Sakijang Bendera), Pulau Semakau and Sentosa (Pulau Blakang Mati).

Table 1. Locations of terrestrial reptile species recorded from the Southern Islands Biodiversity Survey (SIBS) including field data and literature. SIBS indicates taxa observed during surveys 2020-2022. Years correspond to the most recent publication or NParks internal record. RDB3 = Singapore Red Data Book 3 Status, IUCN = International Union for Conservation of Nature Status, BIO = Pulau Biola, BRK = Pulau Berkas, BRN = Pulau Brani, HNT = Pulau Hantu, JNG = Pulau Jong, KEP = Keppel Island, KUS = Pulau Tembakul (Kusu Island), LAZ = Pulau Sakijang Pelepah (Lazarus Island), RAL = Raffles' Lighthouse, SIS = Pulau Subar Laut and Pulau Subar Darat (Sisters' Islands), SJI = Pulau Sakijang Bendera (St John's Island), SMK = Pulau Semakau, SNT = Pulau Blakang Mati (Sentosa Island), TKR = Pulau Tekukor, TPS = Terumbu Pempangs. Acronyms for RDB3/IUCN: EX = Globally Extinct, NEx = Presumed Nationally Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated, NA = Not Applicable, NL = Not Listed.

Family	Scientific name	RDB3	IUCN	BIO	BRK	BRN	HNT	JNG	KEP	KUS	LAZ	RAL	SIS	SJI	SMK	SNT	TKR	TPS
Acrochordidae	*Acrochordus granulatus*	NT	LC												2012, 0			
Agamidae	*Bronchocela cristatella*	LC	NE													2018		
Agamidae	*Calotes versicolor*	NA	NE			SIBS					SIBS			SIBS; 2017	SIBS; 2012	2020		
Agamidae	*Draco sumatranus*	LC	NE													2009		
Alligatoridae	*Melanosuchus niger*	NA	NE													2018*		
Colubridae	*Ahaetulla prasina*	LC	LC													2018		
Colubridae	*Boiga dendrophila*	NT	NE								SIBS			2017	2012			
Colubridae	*Calamaria lovii gimletti*	EN	LC													0		
Colubridae	*Chrysopelea paradisi*	LC	LC										0	2017		2020		
Colubridae	*Dendrelaphis formosus*	VU	LC													2018		
Colubridae	*Dendrelaphis pictus*	LC	NE											2017		2018		
Colubridae	*Lycodon capucinus*	LC	LC								SIBS			2017	2012	2020		
Colubridae	*Oligodon octolineatus*	LC	LC													2018		
Crocodylidae	*Crocodylus porosus*	CR	LC												2012			
Elapidae	*Naja sumatrana*	LC	LC			C										2020		
Emydidae	*Trachemys scripta elegans*	NA	LC								SIBS					2018		
Gekkonidae	*Gehyra mutilata*	LC	NE											SIBS		2020		
Gekkonidae	*Gekko monarchus*	LC	NE								SIBS		2019	SIBS	2012	2020		

*0 = pers. obs., C = pers. comms.to Y. H. J. Tan of an observation during the survey period., * = actual record in 1990 and assumed to be an escapee*

Table 1 continued. Locations of recorded terrestrial reptile species from published and unpublished sources and Southern Islands Biodiversity Survey (SIBS) data. SIBS indicates that taxon was observed during Southern Islands Biodiversity Survey 2019-2022. Year corresponds to most recent publication or NParks internal record with observation of given taxon.

Family	Scientific name	RDB3	IUCN	BIO	BRK	BRN	HNT	JNG	KEP	KUS	LAZ	RAL	SIS	SJI	SMK	SNT	TKR	TPS
Gekkonidae	*Hemidactylus frenatus*	LC	LC				SIBS		SIBS		SIBS		2018	SIBS; 2020	2012	2020	SIBS	
Gekkonidae	*Hemidactylus platyurus*	LC	NE								SIBS		2019			2018		
Gekkonidae	*Lepidodactylus lugubris*	LC	NE											2020	SIBS	2018		
Geoemydidae	*Cuora couro*	NT	VU												2012	2018		
Homalopsidae	*Cerberus schneiderii*	LC	NE												2012			
Scincidae	*Eutropis multifasciatus*	LC	NE													2020		
Scincidae	*Lygosoma bowringii*	LC	NE				0				SIBS		2019		2012	2018		
Typlopidae	*Indotyphlops braminus*	LC	NE													2018		
Varanidae	*Varanus salvator*	LC	LC				SIBS		2015	SIBS	SIBS	0	2019	SIBS; 2017	SIBS; 2012	2020	SIBS	
Viperidae	*Trimeresurus purpureomaculatus*	VU	NE												2012	2009		
Xenopeltidae	*Xenopeltis unicolor*	LC	LC													2018		
Pythonidae	*Malayopython reticulatus*	LC	LC			C	2004	2004		2004			C	2017	2012	2018		

0 = pers. obs. during the survey period

Table 2. Locations of marine reptile species recorded from published and unpublished sources and Southern Islands Biodiversity Survey (SIBS) data. SIBS indicates taxon was observed during Southern Islands Biodiversity Survey 2019-2022. Year corresponds to most recent publication or NParks internal record with observation of given taxon. Abbreviations as in Table 1, plus CYR = Cyrene Reef (Terumbu Pandan).

Family	Scientific name	RDB3	IUCN	BIO	BRK	BRN	CYR	HNT	JNG	KEP	KUS	LAZ	RAL	SIS	SJI	SMK	SNT	TKR	TPS
Cheloniidae	*Chelonia mydas*	CR	EN		SIBS		2021			2020				0		2012	2018		
Cheloniidae	*Eretmochelys imbricata*	CR	CR	SIBS			2021	0	C	2020	0	0	0	2021; 0	2017	2012	1995; C	SIBS; 0	
Elapidae	*Laticauda colubrina*	VU	LC					2013; C			2020		C	2019	2017	2012	2009	C	2020

0 = pers. obs., C = pers. comms.to Y. H. J. Tan of an observation during the survey period

Table 3. Locations of amphibian species recorded from published and unpublished sources and Southern Islands Biodiversity Survey (SIBS) data. SIBS indicates taxa was observed during Southern Islands Biodiversity Survey 2019-2022. Year corresponds to most recent publication or NParks internal record with reptile taxon observation. Abbreviations as in Table 1.

Family	Scientific name	RDB3	IUCN	LAZ	SJI	SMK	SNT	Recently used names in literature
Bufonidae	*Duttaphrynus bengalensis*	NA	NL		2020	2011	SIBS	*Duttaphrynus melanostictus, Bufo melanostictus*
Eleutherodactylidae	*Eleutherodactylus planirostris*	NA	LC				SIBS	*Hylarana planirostris, Rana planirostris*
Discoglossidae	*Fejervarya cancrivora*	LC	LC			2012	2018	*Rana cancrivora*
Discoglossidae	*Fejervarya limnocharis*	LC	LC		SIBS	2012	SIBS	*Rana limnocharis*
Ranidae	*Hylarana erythraea*	LC	LC				2018	*Rana erythraea*
Microhylidae	*Kalophrynus limbooliati*	VU	NT				2018	*Kalophrynus pleurostigmus*
Microhylidae	*Kaloula pulchra*	NA	LC	SIBS	2017	2012	2018	
Microhylidae	*Microhyla butleri*	LC	LC				2018	
Microhylidae	*Microhyla cf. fissipes*	NA	LC				SIBS	
Microhylidae	*Microhyla heymonsi*	LC	LC				2020, SIBS	
Rhacophoridae	*Polypedates leucomystax*	LC	LC	SIBS		2011	2018, SIBS	

Discussion

As with other groups of terrestrial vertebrates, reptile species numbers were greatest on a few of the larger islands: Sentosa (formerly Pulau Blakang Mati) with 25 terrestrial species, Pulau Semakau 14 species and Pulau Sakijang Bendera (St. John's Island) 11 species. If Pulau Sakijang Bendera and Pulau Sakijang Pelepah (Lazarus) are combined, given that they are only 250 m apart and now linked by a motorable manmade causeway with grass verges, their joint total is 14 species.

The most widespread terrestrial reptiles were the Malayan Water Monitor at ten sites and Reticulated Python at eight sites; both are strong swimmers and are evidently able to disperse from island to island. A few other species present at a moderate number of sites included human commensals such as the Common House Gecko *Hemidactylus frenatus* (eight sites), Changeable Lizard *Calotes versicolor* and Spotted House Gecko *Gekko monarchus* (both at five sites). Hitch-hiking on boats, among cargo or construction materials, is a possible mode of spread that has been available for centuries (Muzaini et al., 2025) and still continues. Because of incomplete coverage (e.g., of military and industrial areas on other islands) it is known that the data presented are not a full list: for example the non-native Tokay Gecko *Gekko gecko* had previously been sighted on Pulau Pawai (pers comms to Y.H.J. Tan).

Pulau Semakau, St John's and Lazarus all yielded records of the Mangrove Cat Snake *Boiga dendrophila*. Although the species occurs regionally in mangroves and in riverine forest, within mainland Singapore it is found almost exclusively in and around the centrally located Bukit Timah and Central Catchment Nature Reserves, often near freshwater. The three islands are the only known coastal locations for the species in Singapore, suggesting that they support a population that is (currently) fully isolated from those on the mainland. Overall, the distribution of mangrove-dependent snakes is not well understood. Three species (*Cerberus schneiderii, Acrochordus granulatus*. *Trimeresurus purpureomaculatus*) were recorded from Pulau Semakau which is the island with a large and diverse extent of mangroves, and there is an historical record of *T. purpureomaculatus* from Sentosa in 1990. Difficulty in access to some islands which were not surveyed during SIBS has contributed to a patchy idea of their occurrence.

The full list of native reptiles in Singapore based on Davison et al. (2024) totals 108 species, of which 64 are snakes. The 33 species recorded in and around the Southern Islands represent 30.5% of the total fauna, and the 15 terrestrial and one marine snake species represent 25% of the total snake fauna. The relatively high diversity of snakes from the islands (which comprise only a tiny fraction of the total area of Singapore) can be attributed to the diversity of habitat types available, which in turn supports diverse niches for the snakes. Six species are exclusively arboreal, of which four are mainly associated with terrestrial vegetation and two specialise in riverine/coastal habitats (*Boiga dendrophila* and *Trimeresurus purpureomaculatus*). Four species are fossorial, three are aquatic/marine, and three are generalist in habit. The diets of these snakes are similarly varied; some are specialists, feeding on soil invertebrates (*Calamaria lovii gimletti* and *Indotyphlops braminus*), marine fish (*Acrochordus granulatus*, *Cerberus schneiderii*, *Laticauda colubrina*), or mammals (*Malayopython reticulatus*). Others are more generalist in nature, taking a range of smaller lizards, birds, amphibians, and mammals. However, given the relative lack of amphibians and mammals (a handful of species recorded mainly on the larger islands), the diets of snakes in the Southern Islands may skew more towards alternative prey such as lizards and birds.

Overall, maintaining this diversity of habitat types (e.g. coastal forest, mangrove, coral reef) would be critical to conserving the serpentine biodiversity of these small islands.

Sea turtles are commonly seen surfacing for air around reefs, or underwater by scuba divers, at many of the Southern Islands. This includes islands with recreational, residential, and even landfill use. Anecdotally, most turtles seen by divers are hawksbill turtles, which we have recorded at 13 locations, while green turtles are less commonly sighted and recorded at eight locations. Hawksbills have been recorded to nest on Sisters' Islands, Kusu, Lazarus, St John's, Pulau Tekukor, Pulau Satumu, Sentosa, Pulau Jong, as well as southern islands outside the scope of SIBS such as Pulau Sebarok (pers. comm. to YHJ Tan). They are liable to nest anywhere in the Southern Islands where suitable sandy beaches are present (though in low numbers), and seem to prefer nesting beneath coastal shrubs and trees where possible (pers. obs.). However, their nests are frequently preyed upon by Malayan Water Monitors (*Varanus salvator*), which sniff them out with their keen sense of smell. Long-tailed Macaques (*Macaca fascicularis*) also opportunistically scavenge the remnants left behind by monitors. Retaining sandy beaches would be essential to support the population of this nationally and globally Critically Endangered species, and the National Parks Board (NParks) also intervenes to protect vulnerable nests from predation.

Overall, conservation of the Southern Islands is critical to maintain habitat for marine reptiles, i.e., the Hawksbill Turtle (*Eretmochelys imbricata*), Green Sea Turtle (*Chelonia mydas*), and Yellow-lipped Sea Krait (*Laticauda colubrina*). All three are widely distributed in the area, and the waters around other parts of Singapore appear to be less conducive to these species. Relatively clear and deep water, as well as the presence of coral reefs and seagrass meadows amongst the Southern Islands, are likely to provide suitable habitat and food. Estuarine Crocodiles (*Crocodylus porosus*) have occasionally been reported, for example at Pulau Sudong in 2009 (pers. comm. to YHJ Tan) and at Pulau Semakau in the 1990s (Chua, 2011), and are occasionally spotted along the southern coast of mainland Singapore. Given the presence of substantial mangrove habitat in the Southern Islands, it would not be surprising if they were to be sighted again.

The ten amphibians were all present on Sentosa, five on Pulau Semakau, and two on Saint John's and Lazarus. Not only are these among the larger of the Southern Islands, they are also heavily used and visited by people and have infrastructure such as drains and water tanks that can provide habitat and breeding sites for commensals with man such as *Kaloula pulchra* and *Polypedates leucomystax*. Mown and rough grass areas provide niches for various *Microhyla* species. Given the difficulty for amphibians in crossing marine barriers, it is possible that some of these in the Southern Islands have been transported there accidentally by man, though it cannot be ruled out that some are remnant populations from before sea level rise at the end of the last Ice Age.

The nationally endangered Gimlett's reed snake *Calamaria lowii gimletti* was first recorded in Singapore territory from Pulau Pawai in 1933, and it was rediscovered in the Central Catchment Nature Reserve in 2017 (Serin, Law & Thomas, 2017). Subsequently, large numbers were found at Mount Imbiah in Sentosa by members of the Herpetological Society of Singapore, around the same period as SIBS. Mount Imbiah is a refugium for uncommon species such as this snake and the nationally vulnerable Lim Boo Liat's Sticky Frog (*Kalophrynus limbooliati*). Parts of Mount Imbiah were cleared from the 19th century onwards for the construction of military infrastructure and cleared again to maintain clear lines of fire during wartime. Since 1945 tall secondary forest has grown up, supplemented

by planting by the Sentosa Development Corporation. Since these two species are partly fossorial, it is possible that they represent continuous survivals from historical times. Mount Imbiah is thus a conservation priority; fortunately, it is already part of the Sentosa Nature Area in the Parks and Waterbodies Plan issued by the Urban Redevelopment Authority as part of Singapore's long term land use plan. However, large numbers of the non-native Greenhouse Frog (*Eleutherodactylus planirostris*) were also found at Mt Imbiah during the SIBS exercise and are a possible cause of concern; more study is needed to understand their impact, if any.

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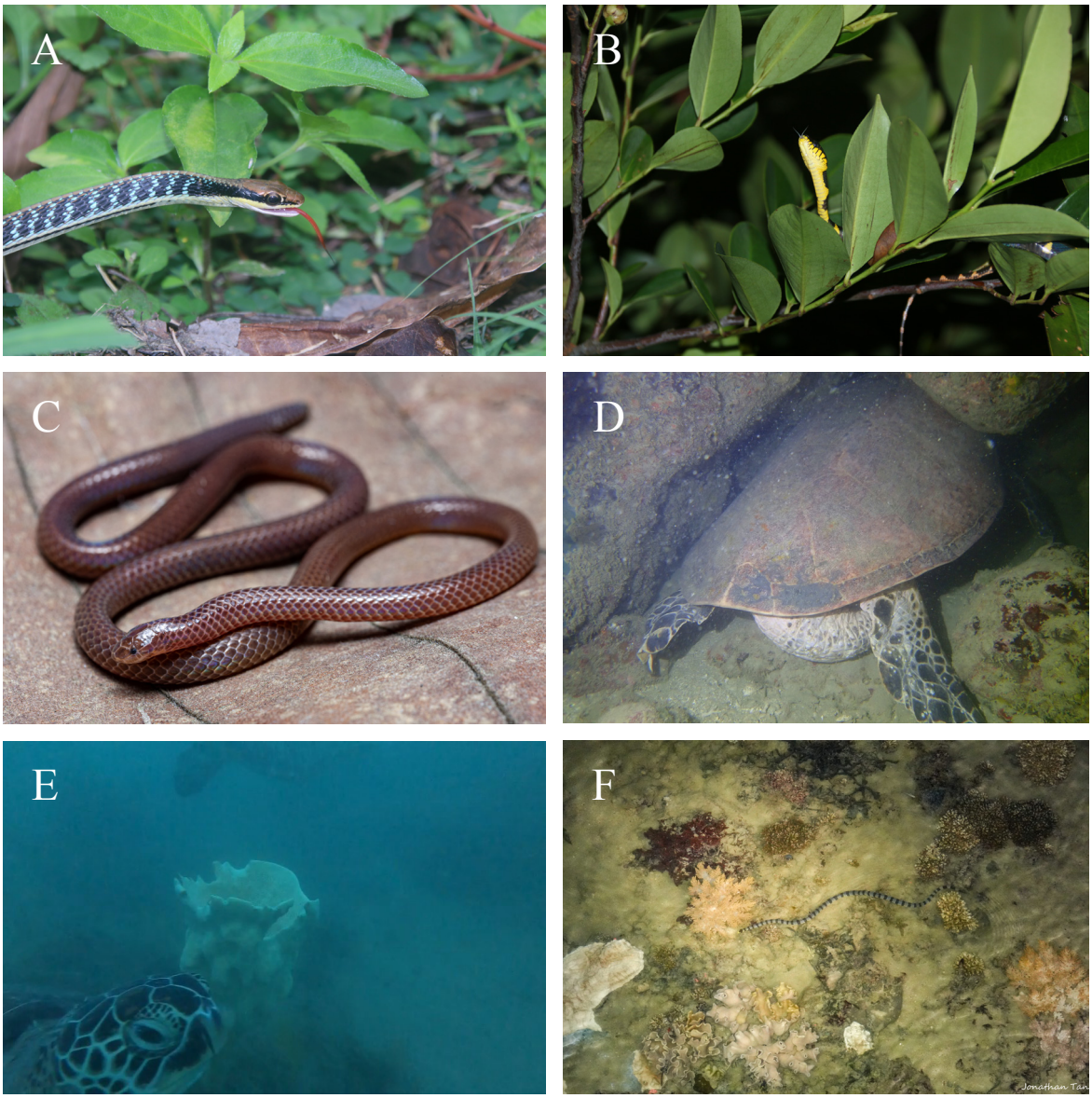
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Appendix 1 (A) Painted Bronzeback (*Dedrelaphis pictus*) at St John's Island, credit: Jonathan Tan. **(B)** Juvenile Gold-ringed Cat Snake (*Boiga dendrophila*) at Lazarus islands, credit: Jonathan Tan. **(C)** Gimlet's Reed Snake (*Calamaria lovi gimletti*) at Sentosa, credit: Law Ing Sind. **(D)** Male Hawksbill Turtle resting in an underwater cave, Raffles Lighthouse, credit: Jonathan Tan. **(E)** Pair of Green Turtles (*Chelonia mydas*) swimming past a Neptune's Cup Sponge (*Cliona patera*), Sisters' Islands, credit: NParks. **(F)** Yellow-lipped Sea Krait (*Laticauda colubrina*), Kusu Island, credit: Jonathan Tan.