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A NOTE ON THE NEW RECORD OF THE REPTILE FAUNA IN PULAU TINGGI, JOHOR, MALAYSIA

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Abstract: Island ecosystem is a fragile ecosystem affected by an ocean climate, which resulting different microclimates, floristic composition and unique habitats. The island's insularity resulted in the unique composition of animal species, especially reptiles which depend most on the microclimate. Hence, a study on reptile diversity was carried out in Pulau Tinggi, Mersing, Johor, from February to October 2019. A previous survey of reptile diversity in Pulau Tinggi was conducted in 2003 and 2006, which recorded 13 and 17 species, respectively and there is an urgent need to update these data. This study used the Visual Encounter Survey (VES) and drift-fenced pitfall traps as the primary sampling methods. Twenty-one species were recorded, which comprise eight families. The Scincidae family recorded the highest number of species, which is five. Meanwhile, Viperidae and Varanidae reported the lowest number of species recorded, one species, respectively. Thirteen species were reported as new records for Pulau Tinggi, resulting in updated reptile diversity in Pulau Tinggi currently to 32 species based on a comparative literature review with previous studies. These new records indicate that extensive and intensive studies are needed to determine the reptilian diversity in Pulau Tinggi for conservation and management purposes.

Keywords: Vertebrate, herpetofauna, island, Johor, Malaysia, Seribuat archipelago, South China Sea.

Introduction

Pulau Tinggi was gazetted as a marine park in 1994 under the fishery act (Department of Marine Park Malaysia, 2012). It is classified as a marine park under The Establishment of Marine Parks of Malaysia Order 1994, conferred by the Fisheries Act 1985 as a protected area on the East Coast of Johor water (Harborne *et al*., 2000). This island, with a total area of 17 km^2 is one of the largest and tallest islands in the East Johor Island Archipelagos (EJIA). The land area in Pulau Tinggi covers approximately 1,524.18 hectares (Department of Marine Park Malaysia, 2012) and the elevation of the hills (Mt. Semudu) is more than 600 meters (Fredolin *et al.,* 2007).

Reptile studies have initially been conducted in the surrounding island which is Pulau Tioman (Hendrickson, 1966a; 1996b; Day, 1990; Lim & Lim, 1999; Grismer *et al.,* 2002), Pulau Tulai (Hendrickson, 1966a; Grismer *et al.,* 2001a), Pulau Aur (Grismer *et al.,* 2001b; Escobar *et al.,* 2003a) and Pulau Pemanggil (Youmans *et al.,* 2002). Based on a reptile survey in Pulau Tinggi reported by Escobar (2003b), 13 species were found, comprising four geckos, two skinks, six agamids and one species of snake from *Colubridae* family. Grismer (2006) reported five species of Gekkonidae, two species of Scincidae, five of Agamidae and five of Colubridae (Grismer, 2006). Recent research provides information on species diversity and updated

reptile diversity in Pulau Tinggi. According to Gangadhar and Shivaji (2016), continuously updated data on the diversity and distribution of reptiles is essential for conservation. As insular islands harbouring unique and enigmatic reptile species, new findings of species are constantly being recorded such as findings by Grismer (2008) at Pulau Singa Besar, Langkawi, Grismer and Norhayati (2008) at Pulau Langkawi, Grismer *et al.* (2002) and Som *et al.* (2020) at Pulau Tioman and Grismer *et al.* (2014) at Pulau Bidong. Therefore, the number of reptile species at Pulau Tinggi remains unknown until an intensive and extensive study is conducted. Thus, this study was undertaken to update the reptiles checklist, as the previous survey was carried out 13 years ago by Grismer *et al.* (2006).

Materials and Methods

Study Area

Pulau Tinggi (2° 18' 21.98" N, 104° 07' 03.86"E) is located in the middle arc of the Seribuat Archipelago, 12 kilometres from the inner arc. The Seribuat Archipelago, located on the southeast coast of Peninsular Malaysia, comprises 62 islands in the southern South China Sea (Ibrahim *et al.,* 2019). The island of the middle arc retains a large area of primary dipterocarp forest, lowland tropical forests, riparian vegetation and mangroves which favour the habitat of reptiles (Grismer, 2006). The weather on this island is hot and humid throughout the year (Department of Marine Park Malaysia, 2012). The low logging activity preserves the island's inner part and maintains the primary forest with a diverse canopy. The low logging activities were held long ago as the opening of old villages around the island, especially at Teluk Sebirah and Kampung Buluh Kasap, which were human settlements before the villagers left. The survey location was conducted on the west coast of Pulau Tinggi, particularly in the forested area of Tlk. Sebirah, Kg. Buluh Kasap, Kg. Pasir Panjang, Kg. Ayer Kolan, Kg. Selepas, Kg. Tanjung Balang, Kg Teluk Pinang and Teluk Pinang Waterfall.

Data Sampling

Two methods were used in this sampling: A Visual Encounter Survey (VES) and Drift Fenced Pitfall Trap (DPT). Visual Encounter Survey was conducted during the night for ten days every month from February 2019 to October 2019, with a group of two to five people surveying from 1900 until 2300. VES's search distance is 0.5 to 2.5 kilometres every sampling night. Visual Encounter Survey was conducted by random selection of area. The survey focuses on the bushy, rocky areas, including forest floors, trails, and riverbanks. DPT is a passive method that is comprised of 20 L buckets that are buried in the soil. Three 10 meters orchid nets were used as fences to drive reptiles into the bucket. The traps were examined before noon every day. Each reptile species caught was photographed and the live colour and pattern were recorded before being released back to their habitat or kept as voucher specimens. The morphological measurements such as snout-vent length, tail length and weight were also recorded. The species were identified using Grismer (2011a; 2011b) and online sources such as The Reptile Database (Uetz *et al.,* 2021). All species were identified up to species level, kept as voucher specimens and deposited at the Universiti Tun Hussien Onn Zoological Collection (UTHMZC).

Results

About 21 reptiles were recorded in Pulau Tinggi (Table 1), comprising eight families: Gekkonidae, Scincidae, Agamidae, Viperidae, Pythonidae, Colubridae, Elapidae and Varanidae. Among those families, Scincidae recorded the highest number of species, five. The families with the lowest number of species are Pythonidae and Varanidae, with only one represented, respectively. Of the reptilian list species, 13 species were newly reported to Pulau Tinggi: *Cnemaspis* cf *kendallii*, *Lygosoma bowringii, Sphenomorphus scotophilus*, *Eutropis longicaudata*, *Boiga dendrophila*, *Oreocryptophis porphyraceus*, *Malayopython reticulatus*, *Tropidolaemus wagleri*, *Naja*

kaouthia, Laticauda colubrina, Bungarus fasciatus, Bungarus candidus and *Varanus salvator*. The number of reptilian species recorded at Pulau Tinggi is 32 (Table 2).

Table 1: Reptile species found in Pulau Tinggi in 2019

Family	Species	Common Name	IUCN Status
Gekkonidae	*Hemidactylus frenatus* (Bleeker, 1857)	Cicak Rumah Ekor Duri	LC
	Cnemaspis kendallii (Gray, 1845)	Kendall's Rock Gecko	LC
Scincidae	*Dasia olivacea* (Gray, 1839)	Olive tree skink	LC
	Mabuya multifasciata (Kuhl, 1820)	Common Mabuya	LC
	Sphenomorphus maculatus (Blyth, 1853)	Spotted Forest Skink	NE
	Eutropis longicaudata (Hallowell, 1857)	Long-tailed Skink	NE
	Lygosoma bowringii (Gunther, 1864)	Bowring's Supple Skink)	NE
Agamidae	*Bronchocela cristatella* (Kuhl, 1820)	Green Crested Lizard	NE
	Draco melanopogon (Boulenger, 1887)	Black Bearded Gliding Lizard	NE
	Aphaniotis fusca (Peters, 1864)	Dusky Earless Agama	LC
Viperidae	*Tropidolaemus subannulatus* (Gray, 1842)	Temple Pitviper	LC
	Tropidolaemus wagleri (Boie, 1827)	Wagler's Pit Viper	LC
Pythonidae	*Malayopython reticulatus* (Schneider, 1801)	Reticulated Python	LC
Colubridae	*Boiga dendrophila melanota* (Boulenger, 1896)	Mangrove cat-snake	LC
	Oreocryptophis porphyraceus (Cantor, 1839)	Black-banded trinket snake	LC
	Dendrelaphis caudolineatus (Gray, 1834)	Striped Bronzeback	LC
Elapidae	*Naja kaouthia* (Lesson, 1831)	Monocled Cobra	LC
	Bungarus fasciatus (Schneider, 1801)	Banded Krait	LC
	Laticauda colubrina (Schneider, 1799)	Yellow-lipped Sea Krait	LC
	Bungarus candidus (Linnaeus, 1758)	Malayan Krait	LC
Varanidae	*Varanus salvator* (Laurenti, 1768)	Water Monitor Lizard	LC

Table 2: List of reptile species found in Pulau Tinggi

Family	Species	Escobar (2003)	Grismer (2006)	This Study (2019)
Gekkonidae	*Hemidactylus frenatus*	√	√	√
	Cnemapis kendali	√	√	√
	Cosymbotus craspedotus	√	√	
	Ptychozoon kuhli		√	
	Gekko monarchus	√	√	
Scincidae	*Dasia olivacea*	√	√	√
	Lygosoma bowringii			√
	Mabuya msiltifasciata	√		√
	Sphenomorphus maculates			√
	Eutropis longicaudata			√
	Eutropis multifasciata		√	
Agamidae	*Bronchocela cristatella*	√	√	√
	Draco formosus	√	√	
	Draco melanopogon	√	√	√
	Draco sumatranus	√	√	
	formosus Boulenger	√		
	Aphaniotis fusca	√	√	√
Colubridae	*Ahaetulla prasina*	√	√	
	Boiga drapiezii		√	
	Boiga dendrophila			√
	Oreocryptophis porphyraceus			Observation
	Dendrelaphis caudolineatus		√	Observation
	Dendrelaphis cyanochloris		√	
	Dryocalamus subannulatus		√	
Viperidae	*Popeia sumatrana*			√
	Tropidolaemus wagleri			√
Pythonidae	*Python reticulatus*			√
Elapidae	*Naja kaouthia*			Observation
	Bungarus fasciatus			Observation
	Laticauda colubrina			Observation
	Bungarus candidus			Observation
Varanidae	*Varanus salvator*			Observation

Note: +: present

Species Notes

Agamidae

***Bronchocela cristatella* (Kuhl, 1820)**
Green crested lizard
Remarks: Two individuals were recorded. The specimens were caught on the forest floor near the small river and the forest trail.

***Draco melanopogon* (Boulenger, 1887)**
Gliding lizard
Remarks: Two individuals of the species were spotted on the tree bark along the forest trail.

***Aphaniotis fusca* (Peters, 1864)**
Earless lizard
Remarks: Three individuals were recorded during the sampling. All specimens were spotted resting on the leaves of herbaceous plants along the forest trail.

Gekkonidae

***Hemidactylus frenatus* (Bleeker, 1857)**
Common house gecko
Remarks: 23 individuals were recorded. This common species was frequently spotted in resort areas, especially green fields.

***Cnemapis kendallii* (Gray, 1845)**
Kendal Rock Gecko
Remarks: 21 individuals were recorded. Most individuals were spotted resting on the tree bark near the small intermittent stream at night.

Cnemaspis* cf. *kendallii
Remarks: One individual was recorded during the sampling. This individual shows different marks, particularly at the medial part of the dorsal head near the postorbital stripe. This individual is close to *C. kendallii* as it has seven vertebral spots. The species were collected on the tree's bark near the small intermittent stream.

Scincidae

***Dasia olivacea* (Gray, 1839)**
Olive tree skink
Remarks: One individual was recorded from a drift-fenced pitfall trap under the forest's shady area of the ecotone zone, between the mangrove and terrestrial forest ecosystems.

***Lygosoma bowringii* (Gunther, 1864)**
Bowringi supple skink
Remarks: One individual was collected from a drift-fenced pitfall trap beside a small river.

***Eutropis multifasciata* (Kuhl, 1820)**
Common Mabuya
Remarks: 18 individuals were recorded during the sampling period. The species were mainly collected from a drift-fenced pitfall trap beside the river.

***Sphenomorphus scotophilus* (Boulenger, 1990)**
Spotted forest skink
Remarks: One individual was recorded from a drift-fenced pitfall trap beside a small river.

***Eutropis longicaudata* (Hallowell, 1857)**
Remarks: One individual was recorded from a drift-fenced pitfall trap beside a small river.

Colubridae

***Boiga dendrophila melanota* (Boulenger, 1896)**
Mangrove cat-snake
Remarks: These species were frequently sighted during sampling night. Two individuals were sighted actively near the forest trail. One dead individual was also sighted at Teluk Sebirah during sampling.

***Dendrelaphis caudolineatus* (Gray, 1834)**
Striped Bronzeback
Remarks: These species were frequently sighted during the daytime, with seven individuals actively spotted at the forest trail.

Elapidae

***Naja kaouthia* (Lesson, 1831)**
Monocled Cobra
Remarks: The species were frequently sighted while crossing the forest trail of the resort.

***Bungarus fasciatus* (Schneider, 1801)**
Banded Krait
Remarks: One individual of this species were spotted during the night-time sampling. The species was active when spotted near the waterfall.

***Laticauda colubrina* (Schneider, 1799)**
Yellow-lipped Sea Krait
Remarks: One individual was spotted at the seashore in front of the resort during the night.

***Bungarus candidus* (Linneaus, 1758)**
Malayan Krait
Remarks: One individual was spotted during the night-time sampling. The species was active when spotted at the forest trail to the waterfall.

Pythonidae
***Malayopython reticulatus* (Schneider, 1801)**
Reticulated python
Remarks: One individual was spotted resting on the rock-dominated forest floor. Three additional individuals were also spotted during the night.

Viperidae
***Tropidolaemus wagleri* (Boie, 1827)**
Wagler's Pit Viper
Remarks: Two individuals were spotted along the forest trail. The animals were resting at night and caught using snake tongs.

Varanidae
***Varanus salvator* (Laurenti, 1768)**
Water Monitor Lizard
Remarks: Four large individuals were spotted during the survey at the mangrove area of Pulau Tinggi.

Discussion

The last survey of reptiles in Pulau Tinggi was conducted by Grismer (2006). Since then, no further study has been conducted. The present research is vital to continuously monitor the reptile diversity in Pulau Tinggi. Grismer *et al*. (2015) prove this in Pulau Langkawi, which recorded several exciting findings of new species and new records of reptiles compared to their previous studies. The additional new records show the need for more studies on this island in addition to the anthropogenic and ecological threat to the reptilian species such as the climate change that might affect this island population which subsequently may drive it to extinction (Foufopoulus *et al.,* 2011).

This group's ability to be distributed widely across the archipelago may reflect the biogeographical event that could support the evidence of the distribution of reptilian species on the island (De Queiroz, 2005). The tropical climate in Malaysia that suits the emergence of various types of reptilian species makes this area rich in biodiversity. However, the insular island ecosystem is fragile as its microclimatic condition is affected by ocean currents and climate (Boomert & Bright, 2007). Thus, the threat of climate change can significantly affect ocean climate, subsequently compromising the island ecosystem. The changes in the island ecosystem, especially its microclimate, will also significantly affect the reptilian population (Belasen *et al.*, 2017). Reptiles are often ignored in conservation efforts due to their size and popularity, resulting in unknown population status for several species of reptiles. Even though these species are always ignored in the conservation effort, they are still crucial in balancing the ecosystem. Thus, continuous inventory is important for conservation and management (Indraneil, 2010).

Snake is considered a keystone species to balance the ecosystem as large predatory mammals are absent in insular islands (Hasegawa, 2003). However, the conservation of snakes is a controversial issue because of the general assumption of the public that all snakes are venomous (Torkar, 2015). Most people assume that all snakes are venomous, which leads to this animal's negative perspective. Reticulated python (*Malayopython reticulatus*) and mangrove cat-snake (*Boiga dendrophila melanota*) were frequently sighted intruding the resort area and village. Several factors may have contributed to this incidence, including a lack of food (Bateman *et al.,* 2021), seasonal changes (Smith *et al.,* 2021) and the location of the village (Yue *et al.,* 2019) near the forest area. Thus, it is crucial to increase awareness among local people to co-exist with snakes and conserve them. The educational program is an excellent resolution to raise awareness among local people (Madden, 2004; Baruch-Mordo *et*

al., 2012) and promote the conservational value of reptiles.

The discovery of new records for lizards and skinks in this study indicates that more species can be discovered in the future with more intense sampling methods and durations. Diverse habitats on Pulau Tinggi such as mangrove swamps on the west coast are suitable habitats for monitoring lizard species (Weijola, 2010) as well as rocky cliffs on the island's east coast suits geckos (Webb & Shine, 2000; Tuniyev & Tuniyev, 2012). Meanwhile, some species of sun skinks prefer open areas such as coastal areas and human settlements to shady areas (Barley *et al.,* 2013). In contrast, agamid lizard species always require woody vegetation habitats such as forests (Diaz *et al.,* 2000) for their habitat. In addition, high island peaks that are always foggy and difficult to reach are believed to be the habitat of various reptile species that have not been recorded yet. The mountain dominated by rocky structures is also a suitable habitat for rock and squat lizards (Grismer *et al.,* 2015).

Conclusion

This study has successfully recorded 21 species which comprise eight families, with 13 species as newly reported in Pulau Tinggi, resulting in the total number of species to 32. An extensive and intensive study of reptilian species should be conducted as the status of Pulau Tinggi as one of the insular islands in the Seribuat Archipelago may harbour more unique species of herpetofauna. Furthermore, a thorough and detailed study would reveal the number of species in Pulau Tinggi, thus, easing the conservation effort of the species.

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