

HERPETOFAUNA DIVERSITY IN SG. DEKA, HULU TERENGGANU, PENINSULAR MALAYSIA

Nur Amalina Mohd Izam¹, Norhayati Ahmad², Shukor Md. Nor², Nur Syuhada Nazron²,
Nurul Adyla Muhammad Nazir², David Magintan³, Farah Ayuni Farinordin¹, Nurul Darsani
Amat Darbis⁴, Mohamad Kamaruddin Zainul Abidin^{1*}.

¹*Faculty of Applied Science*

Universiti Teknologi Mara Pahang, 26400 Bandar Tun Abdul Razak, Pahang, Malaysia.

²*Department of Biology and Biotechnology, Faculty of Science & Technology
Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

³*Department of Wildlife and National Parks, Km10, Jalan Cheras, 56100 Kuala Lumpur,
Malaysia*

⁴*Environment Unit, Tenaga Nasional Berhad Research Sdn. Bhd., 43000 Kajang, Selangor,
Malaysia*

**Corresponding author: kamaruddin.zainul@uitm.edu.my*

Abstract

Sg. Deka is located in Tembat Forest Reserve (TFR), the largest forest reserve in Terengganu. Sg. Deka is known to have ecological bridges for wildlife crossings and serves as a corridor for wildlife to the national park. Sg. Deka is a protected area that serves as a wildlife release site and houses many species of fauna. This survey was conducted in Sg. Deka with the aim of determining the herpetofaunal diversity. The survey was conducted from August 2014 to July 2015. Fenced-pitfall traps and visual encounter survey method were used, as combination of various methods increases the chance to find more species in an area. A species diversity checklist of the herpetofauna in Sg. Deka is presented. A total of 119 herpetofauna individuals were found, comprising of 75 amphibians and 44 reptiles. This checklist includes 12 amphibian species from five families, namely Bufonidae, Dicroglossidae, Megophryidae, Microhylidae, and Ranidae; and 14 reptile species from four families, namely Agamidae, Gekkonidae, Scincidae, and Colubridae. The most dominant species found was *Ingerophrynus parvus*. Further surveys need to be carried out to discover more herpetofauna in Sg. Deka area.

Keyword: Anuran, Biodiversity, Lowland Dipterocarp, Reptile, Tropical Forest

Introduction

Terengganu, is located in the east coast of Peninsular Malaysia, has various types of topographies, including islands, lowlands, hills, and beaches. The lowlands in Terengganu consist of various forms such as settlements, agricultures, and natural forests. Terengganu is covered by forested areas of about 654 625 ha, of which 544 118 ha areas are gazetted as permanent forest reserves. These forests are mainly lowland tropical forests under tropical climate. Terengganu has fairly hot and humid weather and climate all year round, with an average temperature of 26.7 °C, in which May is the hottest month of the year whereas January has the lowest average temperature. The average rainfall in Terengganu is 2736 mm.

The tropical weather in Terengganu promotes tropical biodiversity in its forests. Most forests are lowland dipterocarp forests, thus, they give high economical value to the timber industry. Despite causing damages to the natural ecosystem, logging activities for timbers are actively carried out until now (Piabuo et al., 2021). To mitigate the impacts of logging on natural habitats and their inhabitants, logged forests were left for decades to regenerate into secondary forests, besides implementing selective logging activities (Piabuo et al., 2021). The mitigation steps are believed to replace back the natural habitats that were once disturbed into more suitable habitats for ecology of wildlife and vegetation.

Sg. Deka, is one of the regenerating forests in Terengganu of about 30 years under the management of the Sg. Deka Elephant Conservation Center. The elephant sanctuary here is developed by the Department of Wildlife and National Parks (DWNP) under the supervision of the Ministry of Natural Resources and Environment. This sanctuary is located within the Tembat Forest Reserve (TFR). About 15 000 ha of the TFR area have been allocated by the Terengganu Forestry Department (Anon., 2012) to DWNP to manage this sanctuary and its surrounding environment. This sanctuary set up provides protection and conservation to the elephants, in addition to other wildlife, especially in the states of Terengganu and Kelantan. Sg. Deka also has become the site of the release of wildlife, such as primates, tapirs, and sun bears, as well as attractions for eco-tourism and research activities. In Malaysia, Sg. Deka is one of the wildlife corridors located in the northeast of the National Park and the ecological corridor for the Central Forest Spine (CFS) project. Two other wildlife corridors are Gerik, Perak and Yu River, Pahang. These three corridors have ecological bridges that allow wildlife to cross between forest areas to minimise animal roadkills on highways. The construction of ecological bridges in Sg. Deka has now been placed under the monitoring of the CFS program (Sivananthan, 2012).

Sg. Deka is a natural habitat area rich in wildlife, including herpetofauna (Izam et al., 2016). Herpetofauna is a group of animals, consisting of amphibians and reptiles. Amphibians and reptiles are the cold-blooded animal group, in which their body temperature is affected by their surrounding temperature. Amphibians and reptiles are significant members of food chains and play crucial role in preserving the ecosystem dynamics (Ali et al., 2018). They commonly live in both terrestrial and aquatic environments, whereby a slight change in these environments would affect the survival and reproduction of populations. For example, amphibians' life cycle involves aquatic egg and larval stages that are very sensitive towards physical and chemical changes of the aquatic environment. Adult stage also has very particular habitat requirements and response quickly to slight alterations and disturbance of natural habitats, landscapes and climate. Their high sensitivity towards environment makes them reliable ecosystems' health bio-indicators (Izam et al., 2019). Herpetofauna population can be used to determine the edge effects (Schneider-Maunoury et al., 2016) and restoration success of forests (Diaz-Garcia et al., 2017).

Diversity study involving herpetofauna is important to assess the quality of the environment. Various herpetofauna species live in various niches, from forest floors to canopies. Differences in herpetofauna niches require different sampling effort (Ehwan et al., 2016), to predict the overall populations of herpetofauna presence in an area. Therefore, this study aims to (1) prepare herpetofauna checklist in Sg. Deka, Terengganu; (2) determine herpetofauna diversity in Sg. Deka; and (3) identify the conservation status of herpetofauna found in Sg. Deka.

Study Area

The survey was carried out from August 2014 to July 2015 at Sg. Deka, Hulu Terengganu, Peninsular Malaysia. Sg. Deka (N102°33'31", E5°01'58") borders between Terengganu and Kelantan states. It is located next to Aring, Kelantan. Sg. Deka is located in TFR, which is the

largest forest reserve in Terengganu. Sg. Deka is a lowland dipterocarp forest (**Figure 1**).

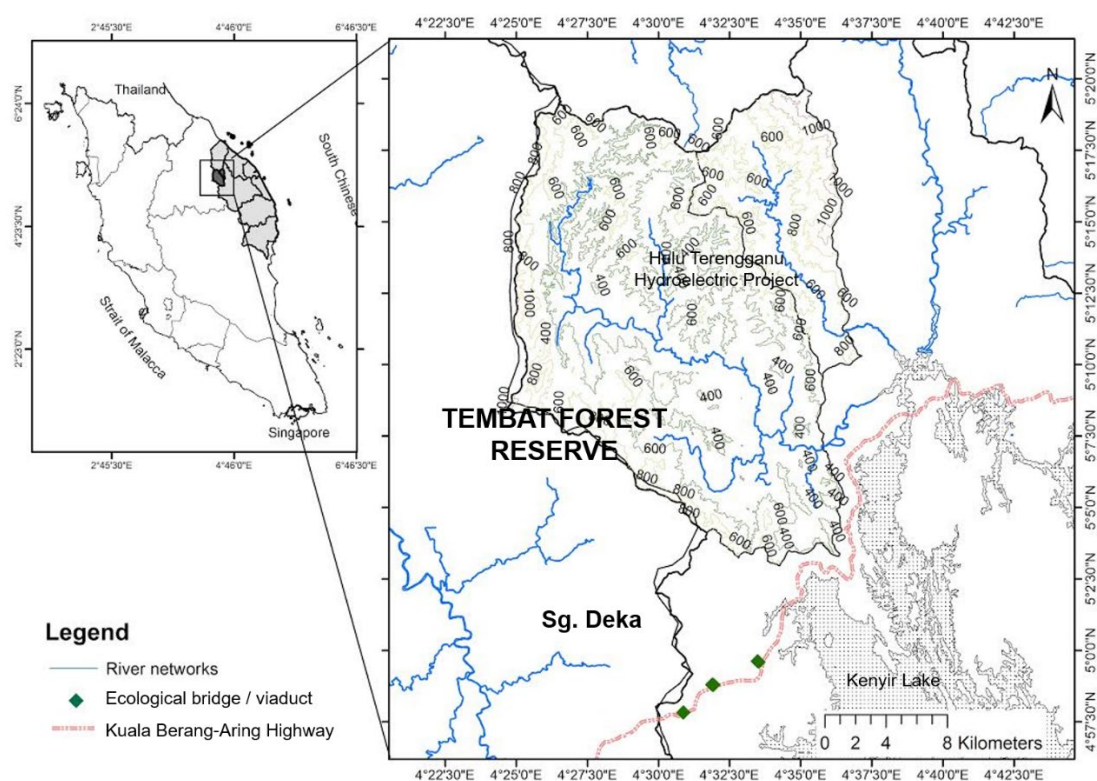


Figure 1 The location of Sg. Deka

Materials and Methods

The primary sampling method in this survey is by using the drift-fenced pitfall traps. Pitfall traps function at night when most herpetofauna are active. These traps are suitable to capture rare and/or seasonal species, as they could be set up throughout the year. Pitfall trap is the most efficient method in capturing high abundance of terrestrial anurans (Greenberg et al., 1994). These traps are designed to catch small sized species, whereas large and medium species could escape away from the trap. Species that can climb or jump higher tend to trespass the drift fences and pitfalls.

The pitfall trap is a “Y” shaped placement of traps made up of four 18 L pails (0.2 m in diameter and 0.5 m deep) and three orchid net fences with 50 to 70 cm height and five meters length (**Figure 2**). The pails were poured with a little amount of water to draw in arthropods, especially insects (food source) and herpetofauna to nest. Holes were drilled about 4 cm from the bottom to drain out excessive water, particularly when raining. The pails were buried into the ground until the lid level. A wood or rock was put into the pail for the animals to climb up to prevent drowning.

In this study, orchid nets with 70% light transparent were used as drift fences. The orchid net fences were set up with poles using a staple gun and were attached closely to the ground using metal wires, so that the animals could not escape below the fences. Since the study area forms an ecological bridge for the wildlife, orchid nets were used in this study, instead of aluminium fences as they are cheaper and easier to maintain when they are damaged by big wildlife like elephants.

An active sampling method called the visual encounter survey (VES) was used in this study to obtain species that could not be caught using the pitfall traps. The VES method is effective in most habitats, especially for species that breed in lentic water. There is no single trapping

method that could catch all species in proportions, constituting their actual richness and abundance (Ehwan et al., 2016). Thus, an alternative method to the pitfall traps would cover species that occupy different niches. The VES involves an active searching for animals by a group of three to four individuals either during night or daytime.

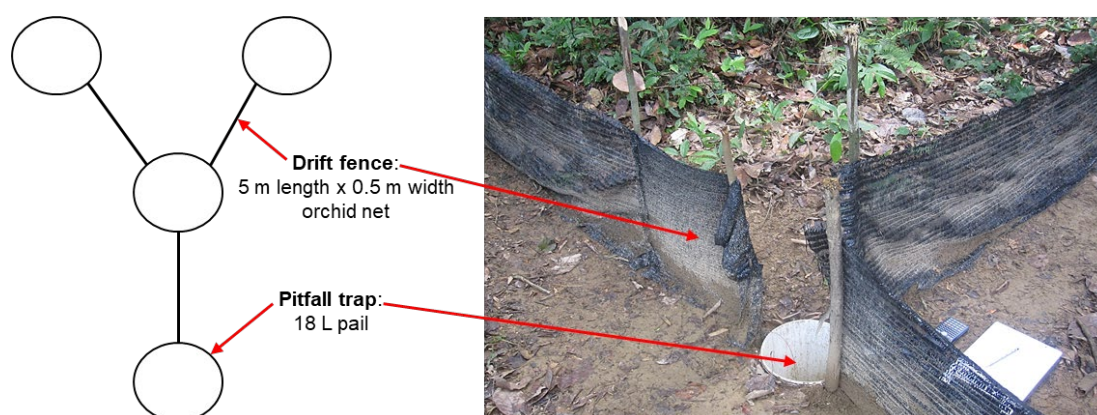


Figure 2 The fenced-pitfall trap design

Result and Discussion

A total of 119 individuals herpetofauna were found, comprising of 75 amphibians and 44 reptiles. The total number of species for amphibians and reptiles were 12 and 14 species, respectively. There were five amphibian families found, namely Bufonidae (toads), Dicroglossidae (forked-tongue frogs), Megophryidae (leaf litter frogs), Microhylidae (narrow-mouthed frogs) and Ranidae (riparian frogs). For reptiles, four families were found, namely Agamidae (lizards), Gekkonidae (lizards), Scincidae (skinks), and Colubridae (snakes).

The dominant amphibian species was *Ingerophrynus parvus* (35%), followed by *Leptobrachium hendricksoni* (28%), and *Kalophrynus pleurostigma* (23%) (**Table 1**). The result was predicted based on a similar study by Izam (2019) done in a hydro dam project within the TFR which had obtained *L. hendricksoni* and *I. parvus* as the dominant species, thus showing that these two species dominated TFR. *Leptobrachium hendricksoni* is a leaf litter frog which was found abundantly at the hydro dam project before the dam construction started, and later was replaced by *I. parvus* due to the canopy removal post dam construction (Izam, 2019). *Leptobrachium hendricksoni* can be found in forest floors with thick leaf litters and is less resistant towards dry environment. Meanwhile, *I. parvus* is a small toad that can be found in terrestrial forested area and is resistant to desiccation. An endangered frog species *Kalophrynus palmatissimus*, was found in Sg. Deka, with only one individual. This species prefers smooth surface leaf litters (Muhammad Faris et al., 2019) and can be found in moist tropical lowland forests. *Kalophrynus palmatissimus* was listed as endangered in the International Union for Conservation of Nature (IUCN) redlist since 2005 until now.

The diversity and richness indices of amphibians in Sg. Deka are relatively moderate (**Table 2**). The total number of species found represents 11 % of the total 111 amphibian species in Malaysia (Norhayati, 2017). Sg. Deka provides continuous canopy layers that provide humid and shady microhabitats for various frog species. The leaf litters in Sg. Deka are also thick, thus providing suitable retreat sites and shelters for food sources (invertebrates) (Muhammad Faris et al., 2019) for many frog species.

Table 1 Species richness and abundance of amphibian found in Sg. Deka and their IUCN status

No.	Species	IUCN Status	Abundance
Bufonidae			
1	<i>Ingerophrynus parvus</i> (Boulenger, 1887)	LC	26 (34.7)
Dicroglossidae			
2	<i>Fejervarya limnocharis</i> (Gravenhorst, 1829)	LC	1 (1.3)
3	<i>Limnonectes khasianus</i> (Anderson, 1871)	NT	1 (1.3)
4	<i>Occidozyga sumatrana</i> (Peters, 1877)	LC	3 (4.0)
5	<i>Limnonectes hascheanus</i> (Stoliczka, 1870)	LC	1 (1.3)
Megophryidae			
6	<i>Leptobrachium hendricksoni</i> Taylor, 1962	LC	21 (28.0)
Microhylidae			
7	<i>Chaperina fusca</i> Macquard, 1892	LC	1 (1.3)
8	<i>Kalophrynus palmatissimus</i> Kiew, 1984	EN	1 (1.3)
9	<i>Kalophrynus pleurostigma</i> Tschudi, 1838	LC	17 (22.7)
10	<i>Microhyla heymonsi</i> Vogt, 1911	LC	1 (1.3)
Ranidae			
11	<i>Amolops larutensis</i> (Boulenger, 1899)	LC	1 (1.3)
12	<i>Pulchrana glandulosa</i> (Boulenger, 1882)	LC	1 (1.3)
Total abundance			75 (100.0)

*Note: Number in brackets represent relative abundance

LC=Least concern, NT=Near threatened, EN=Endangered

Table 2 Diversity of amphibian found in Sg. Deka

No.	Diversity indices	Value
1	Taxa (S)	12
2	Individuals	75
3	Dominance (D)	0.25
4	Simpson (1-D)	0.75
5	Shannon (H)	1.65
6	Evenness ($e^{H/S}$)	0.43
7	Brillouin	1.47
8	Menhinick	1.39
9	Margalef	2.55
10	Equitability (J)	0.66
11	Fisher alpha	4.03

Meanwhile, the most dominant reptile species found was *Sphenomorphus indicus* (27 %), followed by *Eutropis multifasciata* (18 %), and *Gonocephalus liogaster* (14 %) (**Table 3**). High abundance of skinks obtained might be due to the pitfall traps used, as many large reptiles, such as large snakes and lizards could have been escaped from the traps. Besides, the traps might have trapped many insects, particularly ants which served as food source for

these skinks. A riparian skink species *Sphenomorphus sungaicolus* was found, with a pair of individuals obtained in this survey and was reported by Sumarli et al. (2016). This species was found about three to five meters near to the forest stream. In addition, a previously described skink genus was also found near to the stream and was reported as *Tytthoscincus* by Grismer et al. (2018).

Table 3 shows the reptile richness and abundance in Sg. Deka and the IUCN status for each species. Based on **Table 3**, Sg. Deka represented high diversity ($1-D=0.85$), high richness, high equitability ($J=0.85$) and high evenness (0.67) of reptiles as shown in **Table 4**. Sg. Deka has various natural microhabitats, ranging from riparian areas, forest floors to high canopies which provide various niches for different reptile species. Although it is 30 years regenerating forest, it provides a tropical ecosystem suitable for many native species of herpetofauna.

Table 3 Species richness and abundance of reptile found in Sg. Deka and their IUCN status

No.	Species	IUCN Status	Abundance
LACERTILIA (Lizards, geckos, skinks, and varanids)			
Agamidae			
1	<i>Acanthosaura armata</i> (Gray, 1827)	NA	2 (4.5)
2	<i>Aphaniotis fusca</i> (Peters, 1864)	LC	2 (4.5)
3	<i>Calotes versicolor</i> (Daudin, 1802)	NA	1 (2.3)
4	<i>Gonocephalus bellii</i> (Duméril & Bibron, 1837)	LC	1 (2.3)
5	<i>Gonocephalus grandis</i> (Gray, 1845)	LC	4 (9.1)
6	<i>Gonocephalus liogaster</i> (Günther, 1872)	NA	6 (13.6)
Gekkonidae			
7	<i>Cyrtodactylus quadrivirgatus</i> Taylor, 1962	LC	2 (4.5)
Scincidae			
8	<i>Eutropis multifasciata</i> (Kuhl, 1820)	LC	8 (18.2)
9	<i>Lygosoma bowringii</i> (Günther, 1872)	NA	1 (2.3)
10	<i>Sphenomorphus indicus</i> (Gray, 1853)	NA	12 (27.3)
11	<i>Sphenomorphus sungaicolus</i> Sumarli, Grismer, Wood, Ahmad, Rizal, Ismail, Izam, Ahmad, & Linkem, 2016	NA	2 (4.5)
12	<i>Tytthoscincus</i> sp.	NA	1 (2.3)
SNAKES			
Colubridae			
13	<i>Calamaria lumbricoidea</i> Boie, 1827	NA	1 (2.3)
14	<i>Xenochrophis trianguligerus</i> (Boie, 1827)	LC	1 (2.3)
Total abundance			44 (100.0)

*Note: Number in brackets represent relative abundance

NA=Not available, LC=Least concern

Table 4 Diversity of reptile found in Sg. Deka

No.	Diversity indices	Value
1	Taxa (S)	14
2	Individuals	44
3	Dominance (D)	0.16

4	Simpson (1-D)	0.85
5	Shannon (H)	2.23
6	Evenness ($e^{H/S}$)	0.67
7	Brillouin	1.87
8	Menhinick	2.11
9	Margalef	3.44
10	Equitability (J)	0.85
11	Fisher alpha	7.09

Conclusion

In conclusion, Sg. Deka has high diversity and is predicted to house more species of herpetofauna that have yet to be discovered. Although it is a regenerating forest, protection and conservation of this area allows microhabitats to regenerate and mature, thus, providing various suitable niches to different herpetofauna species. High number of species could indicate a healthy ecosystem. Therefore, Sg. Deka representing Tembat Forest Reserve should be continuously protected from any type of disturbance to protect the natural habitat and its inhabitants. Further studies need to be conducted to discover more herpetofauna in Sg. Deka area.

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Conflict of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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