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RESEARCH ARTICLE

Species Checklist and Diversity of the Herpetofauna of Tun Razak Agricultural Research Center, Pahang, Peninsular Malaysia

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Abstract Herpetofauna represents a significant portion of global biodiversity. Understanding their distribution, ecology, and behavior is essential for conservation efforts. Many reptile and amphibian species are threatened or endangered due to habitat loss, pollution, climate change, and disease. A study was conducted to explore the herpetofauna in Tun Razak Agricultural Research Centre from 22 February 2023 to 17 March 2023 through Visual Encounter Survey (VES), covering four types of habitats; ponds, forest, oil palm and residential. A total of 23 species of herpetofauna were recorded, representing 14 amphibians and nine reptiles. *Hylarana erythraea* emerged as the most dominant species, followed by *Fejervarya limnocharis.* These species were found abundantly in ponds due to its suitability for breeding and ample food sources. The presence of these species indicates that the ecosystem has various habitat niches. Most of the species found were globally classified as Least Concern. However, the survey also recorded *Ophiophagus Hannah* and *Cuora amboinensis*, listed as Vulnerable and Endangered respectively. The study highlighted the importance of clean water in ponds for frog breeding, as it ensures proper oxygenation and minimizes exposure to harmful substances. Furthermore, the study demonstrated the potential of herpetofauna as a bioindicator, with changes in their populations reflecting environmental changes or disturbances. The species rank abundance curves showed that the oil palm habitat exhibited the highest species evenness, suggesting a balanced distribution of species within the ecosystem. However, further surveys are needed in the area to determine the full extent of herpetofauna composition. Overall, the findings emphasise the necessity of preserving various habitats to support herpetofauna populations while also maintaining ecosystem health and balance for human-animal coexistence.

Keywords: Amphibian, diversity, forest, oil palm, pond, reptile.

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Introduction

Malaysia's tropical rainforest is rich in species, ecological systems, and environments, making it one of the world's most diversified forests. Malaysia's location near the Equator offers optimal sunlight and precipitation for its tropical rainforest [28]. The warm and humid climate promotes animal growth, leading to a diverse range of species. Malaysia's forests sustain several year-round active herpetofauna species, making it one of the world's most biologically diverse countries [17]. Nevertheless, to meet the current

human demands, the natural landscapes have been modified for the sustenance of economy and social for growing human population. The environmental, social, and governance factors together play significant role to sustainable development, where humans and natural components coexist in modified landscapes.

Of all the terrestrial vertebrates of the world, amphibians and reptiles play 46% role in the maintenance of total species richness [1]. According to recent studies, Malaysia is thought to be home to more than 300 species of amphibians and reptiles combined, making it one of the world's hotspots for herpetological diversity [23, 25]. Herpetofauna play an important ecological role in Malaysia's diverse landscapes and abundant biodiversity as they are useful animal groups to study on a local scale [5, 24]. Herpetofauna are very important in the maintenance of balanced food web which helps in balancing a healthy ecosystem on Earth because they play role as consumers, predators, and prey [1]. Since amphibians are very sensitive to the changes in environment and habitat nature, they work as the indicator to determine the ecosystem stress and habitat condition [1].

Tun Razak Agricutural Research Centre or famously known as Pusat Penyelidikan Pertanian Tun Razak (PPPTR) is a good environment for the livelihood of flora and fauna, especially herpetofauna, due to its diverse ecosystems and distinctive climate. It has a diverse range of environments, including forests, ponds, rivers, oil palm and fruit plantations. This habitat is rich enough to support a diversity of herpetofauna. [11] reported that vegetation types and microhabitat variability appear to affect species richness of amphibians and reptiles. Likewise, a given forestry practice may have different effects on amphibian and reptile communities in terms of reduction or increase in the number of individuals or species present depending on its proximity to pristine or mature forest, wetlands, and other critical habitats [22].

Currently, there is no official record of the diversity and abundance of herpetofauna species in PPPTR. This study will provide a baseline data which can help for effective conservation and long-term survival in this area. It is also valuable for authorities and stakeholders to improve habitat conditions in accordance with sustainable development goals (SDG) and environmental, social, and governance (ESG) principles, while simultaneously conserving diverse herpetofauna species in PPPTR.

Materials and Methods

Sampling Site

This study was carried out at PPPTR (3° 52' 55" N,102° 43' 41" E) (Figure 1), a notable oil palm research center in Malaysia that supplies quality oil palm seeds for many oil palm growers. It is located in Pahang, approximately 22 km from Bandar Tun Abdul Razak, Jengka and 25 km from Jerantut. PPPTR covers around 2400 ha and is generally flat in physical topography. However, certain parts of the site are hilly, sloping, and undulating. There are also approximately seven ponds in this site area. Four habitat types are spotted in this area: forest habitat, pond habitat, oil palm habitat, and residential habitat, with a good humidity level and soil pH level of approximately 6.4. Throughout the year, the average temperature in the area can fluctuate between 25°C (77°F) and 32°C (89.6°F). The research facility focuses on various agricultural topics, such as crop production, livestock breeding, and sustainable land management techniques.

Figure 1. The Map of PPPTR, Pahang, Peninsular Malaysia

Methodology

Throughout the research period from 22 February 2023 until 17 March 2023, the herpetofauna was sampled using visual encounter survey (VES) that assessed species diversity, abundance, and distribution patterns. Herpetofauna is frequently searched through visual encounter survey (VES) from 1930 hours to 2300 hours by four to five observers. Based on [9], weather conditions, habitat characteristics, and observer experiences may affect how well VES works. Species were captured by hand and identified using Frogs and Toads of Malaysia: Malaysia Biodiversity Information System (MyBIS) [18] and also herpetofauna experts. The data obtained was analysed using PAST software version 2.17c for diversity indices and plotting graphs.

Results and Discussion

Overall, 273 individuals of herpetofauna were found in PPPTR. Out of 23 species identified, 14 species from five families were amphibians and nine species from seven families were reptiles (Table 1). The medium-sized frog species (30–45 mm in males and 50–75 mm in females), Green Paddy Frog, *Hylarana erythraea* is the most dominant species (Figure 2). It has distinct red patches behind each eye and a brown or olive-green body coloration with reddish or orange markings on its flanks [16]. It breeds near water bodies, including ponds, marshes, and slowly moving streams [2]. The International Union for Conservation of Nature (IUCN) currently rates the conservation status of *Hylarana erythraea* as Least Concern [14]. Meanwhile, the second most dominant species is the Asian Grass Frog, *Fejervarya limnocharis,* a small to medium-sized frog (2–5 cm) (Figure 2). Physical features of the Asian Grass Frog include a robust body with patterns of spots or stripes, well-developed limbs, and an eye-catching light-colored stripe running from the snout to the shoulder [27]. It can be found abundantly in paddy fields or

wetlands [27]. However, this species can also live in marshes, ponds, streams, and urban areas [30]. The International Union for Conservation of Nature (IUCN) currently rates the conservation status of *Fejervarya limnocharis* as Least Concern [13].

Table 1. List of herpetofauna species in Pusat Penyelidikan Pertanian Tun Razak (PPPTR)

			Habitat types				
Family / Species	**Common name**	**IUCN Status**	**Pond (n)**	**Forest (n)**	**Oil palm (n)**	**Residential area (n)**	**Total abundance (Relative abundance %)**
Class: Amphibia							
Bufonidae							
Ingerophrynus parvus	Lesser toad	LC				3	3 (1.1)
Duttaphrynus melanostictus	Asian common toad	LC			5	6	11 (4.0)
Dicroglossidae							
Fejervarya cancrivora	Crab-eating frog	LC	4	2	2		8 (2.9)
Fejervarya limnocharis	Rice field frog	LC	3	13	14		30 (11.0)
Microhylidae							
Microhyla butleri	Narrow-mouthed / Painted chorus frog	LC		19	6	4	29 (10.6)
Microhyla fissipes	Ornate chorus frog	LC		10	4	2	16 (5.9)
Microhyla heymonsi	Dark-sided chorus frog	LC		13	5	6	24 (8.8)
Kaloula pulchra	Chubby frog	LC	1			4	5 (1.8)
Ranidae							
Hylarana erythraea	Green paddy frog	LC	97				97 (35.5)
Pulchrana glandulosa	Rough-sided frog	LC		4			4 (1.5)
Chalcorana labialis	White-lipped frog	LC		2			2 (0.7)
Rhacophoridae							
Polypedates leucomystax	Four-lined tree frog	LC		6	5	3	14 (5.1)
Polypedates discantus	Malayan slender tree frog	LC			2	3	5 (1.8)
Polypedates macrotis	Dark-eared tree frog	LC				1	1 (0.4)
Class: Reptilia							
Gekkonidae							
Hemidactylus platyurus	Asian house gecko	LC				1	1 (0.4)
Gekko monarchus	Spotted house gecko	LC				1	1 (0.4)
Cyrtodactylus sp.	Forest gecko	LC		1			1 (0.4)
Scincidae							
Eutropis macularia	Bronze grass skink	LC	3		1		4 (1.5)
Varanidae							
Varanus salvator	Common monitor lizard	LC	8				8 (2.9)
Colubridae							
Ptyas korros	Indo-Chinese rat snake	NT		1	4	1	6 (2.2)
Elapidae							
Ophiophagus hannah	King Cobra	VU				1	1 (0.4)
Pythonidae							
Malayopython reticulatus	Reticulated Python	LC				1	1 (0.4)
Geoemydidae							
Cuora amboinensis	Asian box turtle	EN	1				1 (0.4)
	Total		117	71	48	37	273 (100.0)

Notes: LC= Least Concern; NT= Near Threatened;VU= Vulnerable; EN= Endangered

Figure 2. The diversity of amphibians in PPPTR. **(a)** *Ingerophrynus parvus* **(b)** *Duttaphrynus melanostictus* **(c)** *Hylarana erythraea* **(d)** *Pulchrana glandulosa* **(e)** *Chalcorana labialis* **(f)** *Fejervarya cancrivora* **(g)** *Fejervarya limnocharis* **(h)** *Microhyla butleri* **(i)** *Microhyla fissipes* **(j)** *Microhyla heymonsi* **(k)** *Kaloula pulchra* **(l)** *Polypedates leucomystax* **(m)** *Polypedates discantus* **(n)** *Polypedates macrotis*

There are six *Ptyas korros* individuals encountered in PPPTR (Figure 3). The *Ptyas korros* is a non-venomous species that can grow up to three metres in length as an adult. It has a pointed head, smooth scales, and a slim body. Although the snake can have a variety of colors, its common name comes from its distinctive upper lip, which is usually white or pale and is surrounded by a series of dark crossbars [6]. It is a diurnal snake and renowned for its agility and quick movements. As an opportunistic predator, the Indo-Chinese Rat Snake consumes a wide range of prey, including rodents, birds, eggs, and other small vertebrates. In addition to being a skilled swimmer, it is well known for its capacity for tree climbing [6]. The International Union for Conservation of Nature (IUCN) currently rates the conservation status of *Ptyas korros* as Near Threatened. It might be vulnerable to threats like habitat loss, fragmentation, wildlife trade [27] and human persecution because of prejudice and fear [15].

Figure 3. The diversity of reptiles in PPPTR. **(a)** *Hemidactylus platyurus* **(b)** *Gekko monarchus* **(c)** *Cyrtodactylus* sp. **(d)** *Eutropis macularia* **(e)** *Varanus salvator* **(f)** *Ptyas korros* **(g)** *Malayopython reticulatus* **(h)** *Ophiophagus hannah* **(i)** *Cuora amboinensis*

The data presented in Table 2 shows the calculated diversity index values generated from PAST Software. There are seven species found in pond habitat, ten species in forest and oil palm habitat, and 14 species in residential habitats. The Shannon index was used as a diversity indicator (Shannon 1948). Based on Table 2, the residential habitat had the highest species diversity (H'= 2.43), whereas pond habitat showed the lowest value (H'= 0.72). Overall, PPPTR has low diversity of herpetofauna (H'=2.3) according to [31]. Pond habitat has the most individuals since it is a typical habitat for frogs and PPPTR has many ponds. Frogs can breed successfully in ponds because they can access stable water sources for egg-laying and tadpole development [7]. These ponds are rich in food sources, offering a variety of aquatic organisms in large quantities [20]. Additionally, ponds provide the necessary humidity and moisture to maintain the frogs' permeable skin [7].

PPPTR has various environmental conditions and habitats that support the presence of multiple species, particularly generalists. According to [3], species composition of amphibians and reptiles can be used as a positive projection to a healthy ecosystem. Changes in herpetofaunal communities can be used to

detect environmental changes or levels of disturbance because of their distinctive life histories, sensitivity to habitat changes, and particular habitat requirements. For instance, decreases in amphibian populations could be a sign of pollution, habitat loss, or the effects of climate change.

Table 2. Diversity index of herpetofauna in four habitats

	Statistical Values			
	Pond	**Forest**	**Oil Palm**	**Residential**
Total Species	7	10	10	14
Individuals	117	71	48	37
Dominance (*D*)	0.6946	0.1708	0.151	0.103
Simpson Diversity Index (1-*D*)	0.3054	0.8292	0.849	0.897
Shannon Diversity (*H*)	0.7235	1.943	2.086	2.425
Evenness (*E*)	0.2945	0.6977	0.8051	0.8076
Equitability (*J*)	0.3718	0.8437	0.9058	0.919
Fisher alpha	1.633	3.173	3.843	8.203

The species rank abundance curves (RAC) for each habitat (A: pond; B: forest; C: oil palm D: residential area), represent a geometric type of model (Figure 4). Based on the results obtained (Figure 4), the oil palm habitat has the highest species evenness, supported with the low dominance value (D=0.15) (Table 2). Evenness describes the commonness or rarity of a species within a community. A steep gradient in the RAC indicates an uneven distribution of species, where a few dominant species have significantly higher abundances than the rest. On the other hand, a shallow gradient in the RAC denotes high evenness, implying that species abundances are more evenly distributed and that no particular species predominates the community.

The oil palm habitat's higher level of evenness indicates a balanced distribution of species within the community. The other habitats, however, might be subject to various ecological pressures, such as habitat fragmentation or disturbance, which could affect how evenly distributed the species are [32].

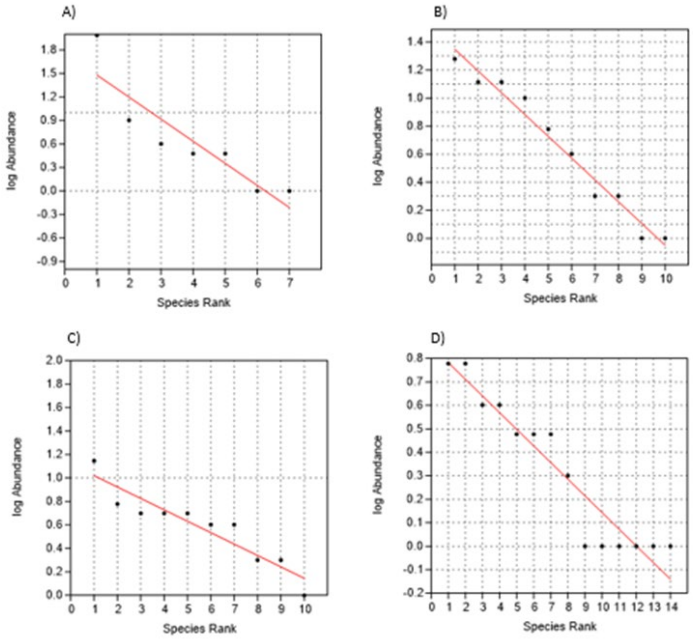

Figure 4. Rank abundance curves analysed using PAST software (A: pond; B: forest; C: oil palm; D: residential area)

Species accumulation curves (SAC) were generated to determine the effectiveness of the surveys. All SACs (Figure 5) were obtained using PAST software. The residential area habitat had the steepest curve, followed by the oil palm habitat, forest habitat, and pond habitat, thus showing that more surveys are needed at the residential area to represent the actual species richness. Oil palm, forest, and pond have curves that are nearly reach asymptote, thus, could represent the actual herpetofauna populations. Residential, oil palm, and forest habitat curves overlapped, indicating that the species richness were not significantly different in these areas. Based on the plotted curve, it is expected that the residential area likely contains the highest species richness, maybe consisting of habitat generalists. Future studies should involve other areas within PPPTR with monthly surveys or longer sampling period to understand temporal variation of herpetofauna in PPPTR.

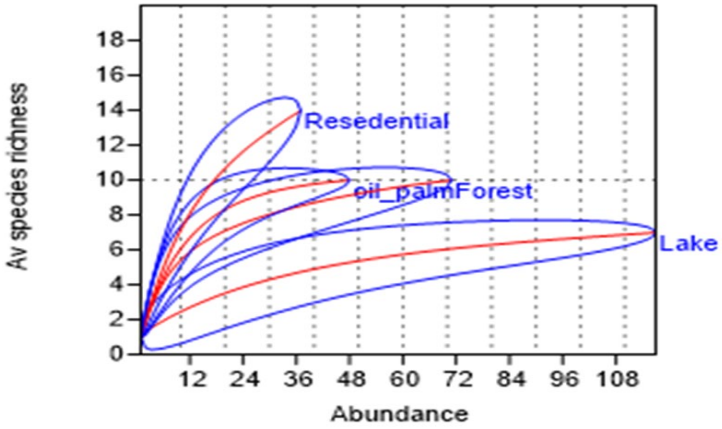

Figure 5. Species accumulation curve for all habitats

Conclusions

In conclusion, the herpetofaunal abundance and species richness in the study areas were found to be relatively high. The diversity of herpetofauna serve as vital indicators of ecosystem health, reflecting habitat conditions, resource availability, ecological interactions, and environmental stability. Nevertheless, risks to herpetofauna may influence the persistence of populations, ultimately increasing the likelihood of extinction, especially for species that are vulnerable or endangered. Therefore, conservation efforts and priorities should be of concern since these areas still harbour ecologically important species. Exploring these populations is vital, not only to identify areas requiring conservation, but also informs habitat restoration and sustainable land-use planning for human-animal coexistence. However, intensive and extensive studies need to be applied to enhance the findings in future studies.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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