

Species composition of Amphibians and Reptiles in Krau Wildlife Reserve, Pahang, Peninsular Malaysia

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ABSTRACT: A revised and updated checklist of the herpetofauna of the Krau Wildlife Reserve (KWR), Pahang is presented, which includes 61 species of amphibians and 65 species of reptiles. Five species of amphibians are listed under revised names *i.e.* *Hylarana labialis*, *H. picturata*, *Ansonia latiffi*, *Microhyla mantheyi* and *Rhacophorus norhayatae*; and two species are listed as new locality records for KWR: *Hylarana cf. siberu* and *Theloderma lacin*. The amphibians and reptiles recorded in KWR are approximately 56% and 22% of the total number of species recorded from Peninsular Malaysia, respectively.

INTRODUCTION

The Krau Wildlife Reserve (KWR) is situated at the east of the Malaysian Main Range (=Titiwangsa Range) and near the basin of Gunung Benom in the Malaysian state of Pahang. This reserve covers an area of 624 km², which makes it the third largest protected area in Peninsular Malaysia. The highest peak within the reserve is Gunung Benom (2,108 m), the third highest mountain in Peninsular Malaysia. Inventories and surveys on the herpetofauna in KWR have commenced since 1972 when the first expedition to Gunung Benom was conducted (Grandison 1972). Since then, other studies have been conducted at various stations within the reserve, such as at Sg. (=River) Chenderoh (Jasmi *et al.* 1999), Bukit Rengit (Salman *et al.* 1999; Norsham *et al.* 2001; Ahmad Shukri 2004; Grace 2006), and Kuala Gandah (Chan *et al.* 2008). These studies, however, were isolated in manner. It is not easy to estimate the actual biodiversity of amphibians as a whole, but diversity of amphibians in KWR has been believed to be relatively well studied based on the many studies listed above. However, this assumption has proven to be erroneous as re-analyses of faunal diversity using different methods (eg. molecular techniques) have resulted in the revision and addition of many new taxa whose status was previously based on morphology (Grandison 1972).

Molecular techniques for associating adult and larval forms of some anurans have resulted in numerous novel species descriptions (Shimada *et al.* 2007), while others have been synonymized (Matsui *et al.* 2007a), resurrected (Matsui *et al.* 2007) or revised under a different nomen (Chan and Grismer 2010). Another method that was used to delimit species boundaries is acoustic characteristics that can be used as a proxy for reproductive isolation. Two new amphibian species were recently described from

the Peninsular Malaysia using this technique (Matsui *et al.* 2009; Matsui 2009). This paper provides an overview of the herpetofauna of KWR, with additional data based on an intensive 12 month period of drift-fenced pitfall trappings and visual encounter surveys of amphibians at Kuala Gandah field station (one of the five field stations in KWR) and with some notes on revised taxa, ecology, and distribution of the less common species based on compilation of species list from all previous studies in KWR. Knowledge of species richness and community structures is important for conservation and governance on sustainable management of the environment. Such clarification is required to focus effort at crucial areas such as areas with high density of rare species, and areas that are threatened by landscape alteration to initiate mitigation process. Thus, the objectives of this study were to: (1) to document species richness in the region from past and current studies with notes on their current taxonomic status. (2) to examine patterns of community structure and composition, (2) to document taxa occurring species richness in the region from past and current studies with notes on their current taxonomic status.

MATERIALS AND METHODS

Study Area

KWR is predominantly covered with lowland dipterocarp forests at the east and highland forests at the west. The reserve is drained by three major river systems, Sg. Krau, Sg. Lompat, and Sg. Teris. The landscape ranges from flat lowlands to undulating hilly terrain, with altitude ranges of 43 – 2,107 m. The reserve was established in 1923, starting with a total area of 552 km². It was regazetted twice in 1965 and 1968 until it reached its present size of 624 km² (Perhilitan/Danced 2001). The average annual

rainfall is about 2000 mm and the daily temperature fluctuates between a minimum of 23°C to a maximum of 33°C. There are five stations within this reserve, all of which are under the management and administration of the Department of Wildlife and National Parks (DWNP) or PERHILITAN: Kuala Lompat Research Station (KL), Lubuk Baung (LB), Kuala Sungai Serloh (KS), Kuala Gandah (KG), and Jenderak Selatan (JS).

Study site

The study focused on Kuala Gandah (3°36'00" N, 102°09'04" E) (Figure 1), which is located at the south of KWR, where the National Elephant Conservation Centre is also located. Permission to study here was granted by the DWNP. There are several villages of the indigenous *Orang Asli Che Wong* (Che Wong tribe) villages in the area, with a total of 45 households around the reserve (Haemamalar et al. 2010). The Che Wong is of the *Senoi* sub-group, who resides mainly in the forest of Pahang state in Peninsular Malaysia. They depend substantially on forest produce. Other tribes that live here are *Temuan* and *Jah Hut*. They maintain many narrow motorbike trails in the reserve as their means of travelling in and out of the forest to the nearest town to get supplies. Some of these trails are included in the plot.

Method

Survey methods include drift-fenced pitfall trapping, diurnal and nocturnal censuses, and opportunistic searches. A total of 126 traps were set up in a 400 x 400 m grid (Figure 2). The grid was further subdivided into 16 sub-grids, each measuring 100 x 100 m. A total of 9 traps

were set upper line in this subgrid, with a distance of 5 m between traps. Galvanized metal drift fences 0.3 m in height were buried ~5 cm below soil surface to prevent animals from burrowing under them. Pitfall traps consist of 18-L plastic buckets (0.5 m deep and 0.2 m in diameter) (Figure 3). Drain holes were punched at the bottom of each bucket and buried flush with the ground surface, with the drift fence overhanging the lip of each pitfall trap. The traps were opened for 7 continuous days each month for 12 consecutive months and were examined once a day before noon.

The visual encounter survey procedure consisted of active searching for animals using wide-beam headlights at a steady pace within a constrained area along the trails at a specific time at night, usually within the first 2-4 h after dark fall (Table 1). Surveys were conducted for 7 continuous days per month for 12 months. Time spent surveying depended on the density of animals per unit area, based on the pit-fall collection. Animals were caught by hand and brought back for measurements.

Voucher specimens for most taxa were collected to aid the identification of unknown taxa and to collect tissue samples for taxonomic groups requiring further taxonomic resolution. All specimens are deposited at the Institute of Biodiversity, DWNP, Bukit Rengit, KWR. Taxonomic nomenclature follows the Amphibian Species of the World 5.3 by the American Museum of Natural History (<http://research.amnh.org/herpetology/amphibia/>), last accessed on 5 June 2009. Taxonomy for *Hemidactylus* follows Carranza and Arnold (2006); *Draco* taxonomy follows (Manthey 2008).

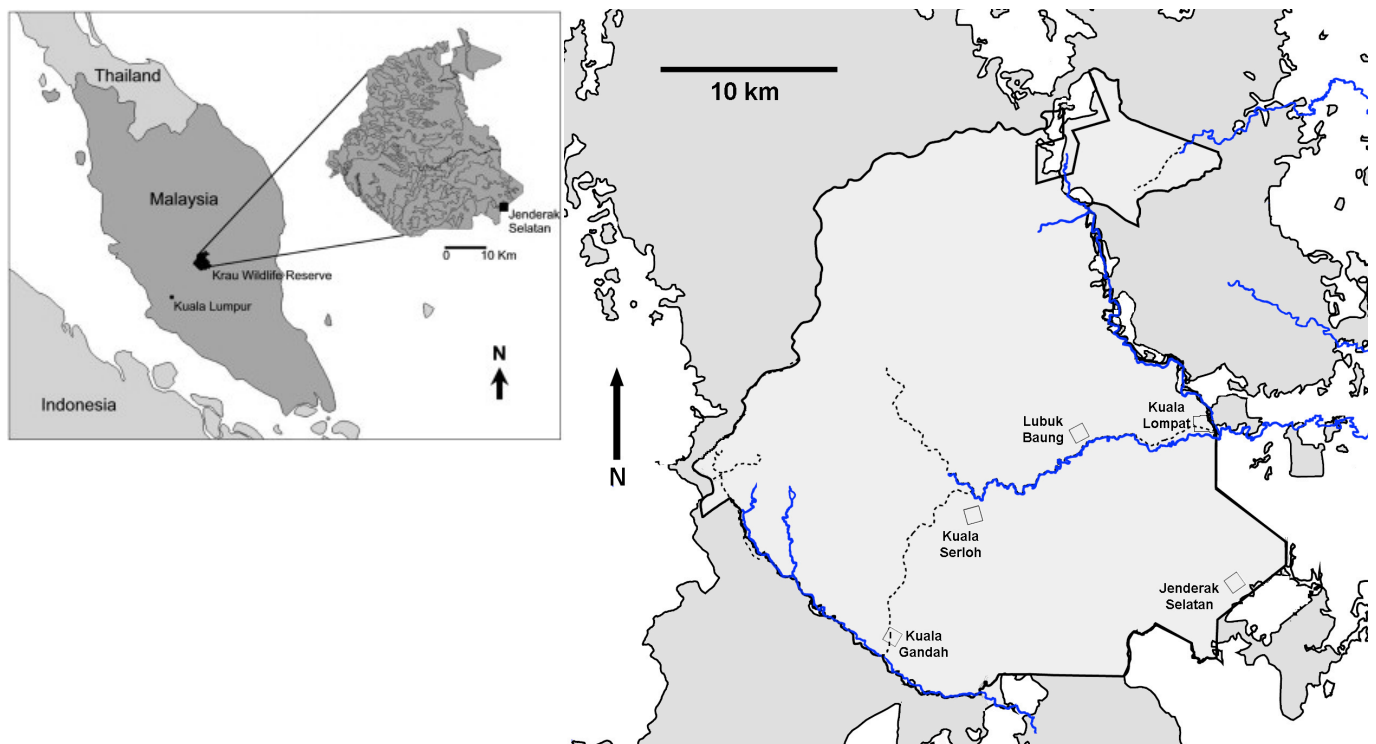


FIGURE 1. Map of Krau Wildlife Reserve, Pahang. The reserve is represented by light grey, forest area outside the reserve by dark grey, and non-forest areas by white [Courtesy of M. Struebig (unpublished)].

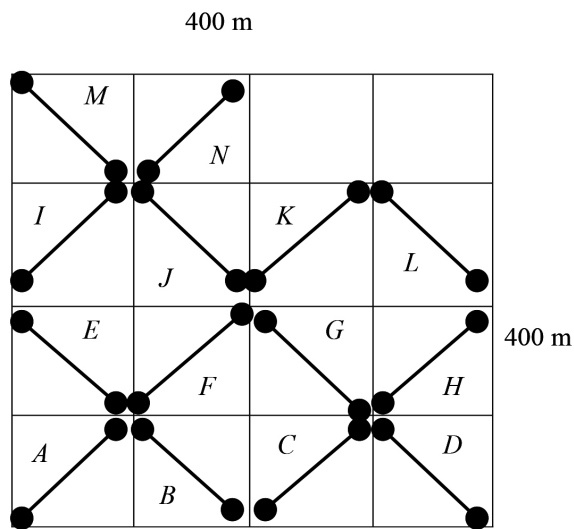


FIGURE 2. The 400 x 400 m grid at Kuala Gandah where the traps were laid along 14 designated lines A to N.

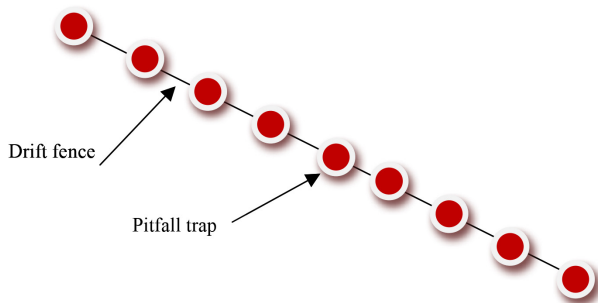


FIGURE 3. A line where 9 pitfall traps were laid every 5 m apart along the fence.

TABLE 1. The dates of pitfall trappings and visual encounter surveys (VES).

MONTH	PITFALL TRAPPING	VES
Aug 2009	19 - 25 Aug 2009	25 - 31 Aug 2009
Sep	11 - 17 Sep 2009	05 - 11 Sep 2009
Oct	15 - 21 Oct 2009	22 - 28 Oct 2009
Nov	02 - 08 Nov 2009	15 - 21 Nov 2009
Dec	16 - 22 Dec 2009	09 - 15 Dec 2009
Jan 2010	19 - 25 Jan 2010	25 - 31 Jan 2010
Feb	22 - 28 Feb 2010	15 - 21 Feb 2010
Mar	01 - 07 Mar 2010	07 - 13 Mar 2010
Apr	24 - 30 Apr 2010	15 - 21 Apr 2010
May	21 - 27 May 2010	13 - 19 May 2010
Jun	22 - 28 Jun 2010	15 - 21 Jun 2010
Jul	17 - 23 Jul 2010	22 - 28 Jul 2010

RESULTS AND DISCUSSION

A total of 1,045 individuals were obtained, comprising 13 families and 38 species (Table 2). The total frogs was 929, comprising 6 families and 24 species; Bufonidae (2 species), Dicroglossidae (6 species), Megophryidae (3 species), Microhylidae (6 species), Ranidae (6 species) and Rhacophoridae (1 species). For reptiles, a total of 116 individuals were sampled, comprising 7 families and 14 species: Agamidae (2 species), Bataguridae (1 species), Colubridae (2 species), Gekkonidae (2 species), Scincidae (4 species), Typhlopidae (1 species) and Varanidae (2 species). The most sampled anuran species were *Micryletta inornata* (about 45% of the total amphibians), followed

by *Ingerophrynus parvus* (19%), and *Megophrys nasuta* (6%). Among the reptiles, *Cyrtodactylus quadrivirgatus* was the most frequently sampled (29% of the total reptiles), followed by *Aphaniotis fusca* (27%) and *Eutropis multifasciata* (18%).

The species accumulation curve shown in Figure 4 reflects the same scenario in most studies of vertebrate communities in which the curve rises steeply at first and levels off in later samples as increasingly rare taxa are added (Gotelli and Colwell 2001). Meanwhile, the asymptote point shows the estimated species richness in the area of study was 38. The species accumulation curve showed no leveling off into an asymptote, suggesting that our sampling did not represent the true species richness in the area.

The total number of amphibian species from Krau Wildlife Reserve includes five that were recently revised and one new locality record. The revised taxa are: *Hylarana labialis* (previously *H. raniceps*: Inger et al. 2009), *H. picturata* (previously *H. signata*: Brown and Guttman 2002), *Ansonia latiffi* (previously *A. leptopus*: Wood et al. 2008), and *Microhyla mantheyi* (previously *M. borneensis*: Das et al. 2007); and *Rhacophorus norhayatae* (previously *R. reinwardtii*: Chan and Grismer 2010). From the current study, *Ingerana tenasserimensis* (Ranidae) represents new locality record for KRW.

Gonocephalus bornensis (Schlegel, 1848) was included in the list by Grandison (1972), but it is not known to occur in Peninsular Malaysia (Grismer 2011). It is reported from Indonesian Borneo (de Rooij 1915), Sabah and Sarawak (Das 2004), and Thailand, but reported only once near the border of Surat Thani and Nakhon Si Thammarat (fide Taylor 1963). Thus, this species is omitted from the current list. *Cnemaspis affinis* (Stoliczka, 1870) has been restricted to Penang Island (Grismer et al. 2008), and thus, *C. affinis* reported by Grandison (1972) should be assigned to *Cnemaspis flavolineata* (fide Grismer et al. 2008). *Cyrtodactylus marmoratus* is not known to occur in Malaysia (Grismer 2011), and thus, omitted from the current list. From the current study, there are four reptile species of new locality records for KRW: *Varanus dumerillii* (Varanidae), *Ramphotyphlops braminus* (Typhlopidae), *Dryocalamus subannulatus* (Colubridae) and *Heosemys spinosa* (Bataguridae).

Referring to Table 3, *Rana chalconota* (indicated by asterisks) was recently resolved at the species level to be *Hylarana labialis* (Inger et al. 2009). *Draco fimbriatus* Kuhl, 1820 and *Draco punctatus* Boulenger, 1912 are actually synonyms. Meanwhile, those indicated by the symbol ^ were reexamined and described as new species, such as *Ansonia (leptopus) latiffi* (Wood et al. 2008), *Rhacophorus (reinwardtii) norhayatae* (Chan and Grismer 2010) and *Microhyla (borneensis) mantheyi* (Das et al. 2007).

The latest publication on the herpetofauna of Krau was by Chan et al. (2008), in which many new records were obtained using pit-fall traps, which captured numerous ground-dwelling frog species, such as *Ingerophrynus quadriporcatus*, *Limnonectes paramacrodon*, *L. malesianus*, *Kaloula baleata*, *Leptobrachium nigrops*, *Calluella minuta*, *Kalophrynus palmatissimus*, *Microhyla mantheyi*, *Micryletta inornata*, *Hylarana siberu* and *H. laterimaculata*. The current study, which also used pit-fall method,

TABLE 2. Species and relative abundance of amphibians and reptiles sampled at Kuala Gandah, Krau Wildlife Reserve, Pahang (numbers in brackets are in percentages).

NO.	TAXA	VOUCHER NO.	PITFALL	VES	TOTAL
Order Anura					
Bufonidae					
1	<i>Ingerophrynus parvus</i>	UKMHC065	147	27	174 (18.7)
2	<i>Ingerophrynus quadriporcatus</i>	UKMHC066	43	0	43 (4.6)
Dicroglossidae					
3	<i>Fejervarya limnocharis</i>	UKMHC067	15	8	23 (2.5)
4	<i>Limnonectes blythii</i>	UKMHC068	1	11	12 (1.3)
5	<i>Limnonectes kuhlii</i>	UKMHC069	1	0	1 (0.1)
6	<i>Limnonectes paramacrodon</i>	UKMHC070	1	0	1 (0.1)
7	<i>Limnonectes plicatellus</i>	UKMHC071	12	0	12 (1.3)
8	<i>Occidozyga laevis</i>	UKMHC072	30	12	42 (4.5)
Megophryidae					
9	<i>Leptobrachium nigrops</i>	UKMHC073	0	3	3 (0.3)
10	<i>Megophrys nasuta</i>	UKMHC074	49	4	53 (5.7)
11	<i>Xenophrys aceras</i>	UKMHC075	1	0	1 (0.1)
Microhylidae					
12	<i>Calluella minuta</i>	UKMHC076	0	30	30 (3.2)
13	<i>Kalophrynus palmatissimus</i>	UKMHC077	4	0	41 (4.4)
14	<i>Kalophrynus pleurostigma</i>	UKMHC078	3	0	4 (0.4)
15	<i>Kaloula baleata</i>	UKMHC079	41	0	3 (0.3)
16	<i>Kaloula pulchra</i>	UKMHC080	0	12	12 (1.3)
17	<i>Micryletta inornata</i>	UKMHC081	413	0	413 (44.5)
Ranidae					
18	<i>Hylarana erythraea</i>	UKMHC082	0	13	13 (1.4)
19	<i>Hylarana nicobariensis</i>	UKMHC083	0	3	3 (0.3)
20	<i>Hylarana labialis</i>	UKMHC084	0	13	13 (1.4)
21	<i>Hylarana laterimaculata</i>	UKMHC085	10	0	10 (1.1)
22	<i>Hylarana picturata</i>	UKMHC086	5	11	16 (1.7)
23	<i>Ingerana tenasserimensis</i>	UKMHC087	1	0	1 (0.1)
Rhacophoridae					
24	<i>Polypedates leucomystax</i>	UKMHC088	0	5	5 (0.5)
Total Order Anura			777 (83.6)	152 (16.4)	929 (100)
Orders Squamata and Testudines					
Agamidae					
25	<i>Aphaniotis fusca</i>	UKMHC089	31	0	31 (26.7)
26	<i>Draco melanopogon</i>	UKMHC090	1	0	1 (0.9)
Gekkonidae					
27	<i>Cyrtodactylus quadrivirgatus</i>	UKMHC091	34	0	34 (29.3)
28	<i>Cnemaspis kendallii</i>	UKMHC092	6	0	6 (5.2)
Colubridae					
29	<i>Calamaria lumbricoidea</i>	UKMHC093	1	0	1 (0.9)
30	<i>Dryocalamus subannulatus</i>	UKMHC094	2	0	2 (1.7)
Typhlopidae					
31	<i>Ramphotyphlops braminus</i>	UKMHC095	5	0	5 (4.3)
Scincidae					
32	<i>Eutropis multifasciata</i>	UKMHC096	21	0	21 (18.1)
33	<i>Lipinia vittigera</i>	UKMHC097	1	0	1 (0.9)
34	<i>Lygosoma bowringii</i>	UKMHC098	2	0	2 (1.7)
35	<i>Sphenomorphus cyanolaemus</i>	UKMHC099	3	0	3 (2.6)
Varanidae					
36	<i>Varanus dumerilii</i>	UKMHC100	3	0	3 (2.6)
37	<i>Varanus salvator</i>	UKMHC101	1	0	1 (0.9)
Bataguridae					
38	<i>Heosemys spinosa</i>	UKMHC102	5	0	5 (4.3)
Total Orders Squamata and Testudines			116 (100.0)	0 (0.0)	116 (100)
Grand Total			893 (85.5)	152 (14.5)	1045 (100.0)

managed to obtain another additional record, which is *Ingerana tenasserimensis* (Ranidae). From the latest checklist provided in Table 3, there are now 61 species of amphibians and 68 species of reptiles recorded in KWR, which are approximately 56% and 24% of the total number of species recorded from Peninsular Malaysia, respectively.

Habitat loss of many organisms is still occurring in vast

areas of tropical Asia including Malaysia. Herpetofaunal diversity, especially of frogs, that are well-known environmental indicators, can provide valuable data usable for environmental conservation relating to the monitoring of biological diversity in Malaysia. This updated checklist can serve as a starting point to help future researchers form long-term strategies in response to habitat and climate change.

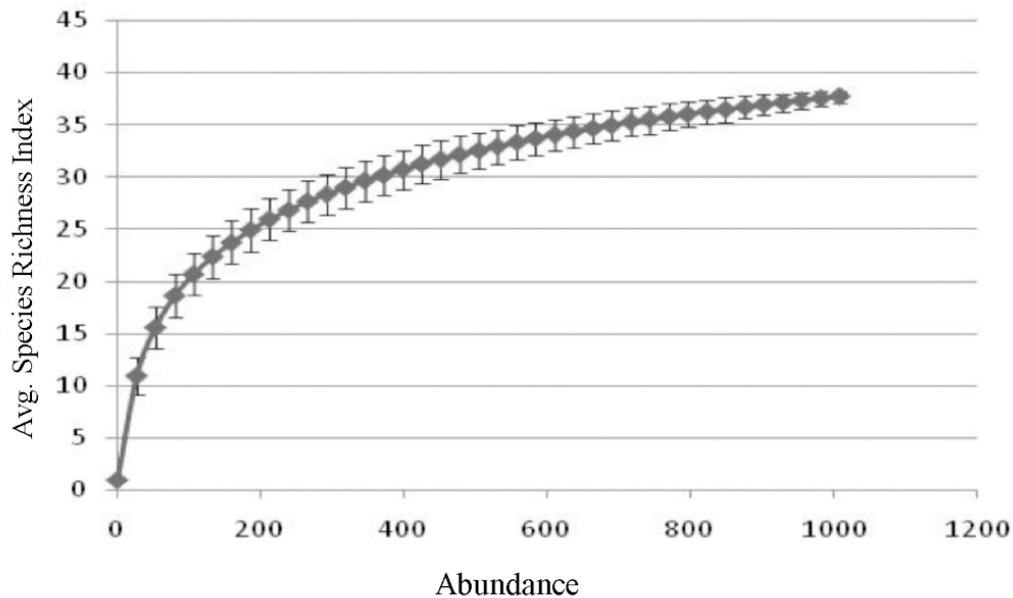


FIGURE 4. Accumulation graph of average Species Richness Index of herpetofauna sampled using the pit-fall traps.

TABLE 3. Updated and revised checklist of herpetofauna of Krau Wildlife Reserve, Lanchang, Pahang.

No.	Family/Species	Grandison (1972)	Norsham et al. (2001)	Jasmi et al. (1999)	Salman et al. (1999)	Lim, B. L. 1999.	Grace (2006)	Chan et al. (2008)	Grismer (2011)	This study
AMPHIBIANS										
Ichthyophiidae										
1	<i>Caudacaecilia nigroflava</i> (Taylor 1960)	+								
2	<i>Ichthyophis glutinosus</i> (Linnaeus, 1758)					+				
Bufonidae										
3	<i>Ansonia latiffi</i> Wood, Grismer, Ahmad & Senawi, 2008 [^]	+				+				
4	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)		+	+	+	+				
5	<i>Ingerophrynus parvus</i> (Boulenger, 1887)	+	+	+		+	+	+		+
6	<i>Ingerophrynus quadriporcatus</i> (Boulenger, 1887)							+		+
7	<i>Leptophryne borbonica</i> (Tschudi, 1838)	+				+				
8	<i>Pedostibes hosii</i> (Boulenger, 1892)			+		+				
9	<i>Pelophryne signata</i> (Peters, 1867)	+				+				
10	<i>Phrynoidis aspera</i> (Gravenhorst, 1829)	+	+	+		+	+	+		
Dicroglossidae										
11	<i>Fejervarya cancrivora</i> (Gravenhorst, 1829)			+						
12	<i>Fejervarya limnocharis</i> (Gravenhorst, 1829)	+	+	+	+	+		+		+
13	<i>Limnonectes blythii</i> (Boulenger, 1920)	+	+	+	+	+	+	+		+
14	<i>Limnonectes kuhlii</i> (Tschudi, 1838)						+			+
15	<i>Limnonectes laticeps</i> (Boulenger, 1882)	+	+			+	+			
16	<i>Limnonectes malesianus</i> (Kiew, 1984)							+		
17	<i>Limnonectes paramacrodon</i> (Inger, 1966)							+		+
18	<i>Limnonectes plicatellus</i> (Stoliczka, 1873)	+				+		+		+

TABLE 3. CONTINUED.

No.	Family/Species	Grandison (1972)	Norsham et al. (2001)	Jasmi et al. (1999)	Salman et al. (1999)	Lim, B. L. 1999.	Grace (2006)	Chan et al. (2008)	Grismer (2011)	This study
19	<i>Limnonectes tweediei</i> (Smith, 1935)	+				+				
20	<i>Occidozyga laevis</i> (Günther, 1858)		+					+		+
Megophryidae										
21	<i>Leptobrachium hendricksoni</i> Taylor, 1962			+						
22	<i>Leptobrachium nigrops</i> Berry & Hendrickson, 1963							+		+
23	<i>Leptolalax gracilis</i> (Günther, 1872)	+				+				
24	<i>Leptolalax heteropus</i> (Boulenger, 1900)	+				+				
25	<i>Megophrys nasuta</i> (Schlegel, 1858)	+	+	+		+		+		+
26	<i>Xenophrys aceras</i> (Boulenger, 1903)	+				+				+
Microhylidae										
27	<i>Calluella minuta</i> Das, Yaakob & Lim, 2004							+		+
28	<i>Chaperina fusca</i> Mocquard, 1892	+				+				
29	<i>Kalophrynus palmatissimus</i> Kiew, 1984							+		+
30	<i>Kalophrynus pleurostigma</i> Tschudi, 1838	+				+		+		+
31	<i>Kaloula baleata</i> (Müller in Van Oort & Müller, 1833)							+		+
32	<i>Kaloula pulchra</i> (Gray, 1831)									+
33	<i>Metaphrynella pollicaris</i> (Boulenger, 1890)	+				+				
34	<i>Microhyla annectans</i> Boulenger, 1900	+				+				
35	<i>Microhyla berdmorei</i> (Blyth, 1856)	+				+				
36	<i>Microhyla butleri</i> Boulenger, 1900	+	+	+		+				
37	<i>Microhyla heymonsi</i> Vogt, 1911	+	+	+	+	+		+		
38	<i>Microhyla mantheyi</i> Das, Yaakob & Sukumaran, 2007 [^]							+		
39	<i>Micryletta inornata</i> (Boulenger, 1890)							+		+
40	<i>Phrynella pulchra</i> Boulenger, 1887	+				+				+
Ranidae										
41	<i>Amolops larutensis</i> (Boulenger, 1899)	+				+				
42	<i>Humerana miopus</i> (Boulenger, 1918)	+	+	+		+				
43	<i>Hylarana erythraea</i> (Schlegel, 1837)		+	+		+				+
44	<i>Hylarana glandulosa</i> (Boulenger, 1882)		+	+		+				
45	<i>Hylarana labialis</i> (Boulenger, 1887)*	+	+	+		+	+	+		+
46	<i>Hylarana laterimaculata</i> (Barbour & Noble, 1916)							+		+
47	<i>Hylarana luctuosa</i> (Peters, 1871)	+				+				
48	<i>Hylarana nicobariensis</i> (Stoliczka, 1870)	+	+	+		+				+
49	<i>Hylarana picturata</i> (Boulenger, 1920)	+	+	+		+	+	+		+
50	<i>Ingerana tenasserimensis</i> (Sclater, 1892)									+
51	<i>Odorrana hosii</i> (Boulenger, 1891)	+	+			+	+			
Rhacophoridae										
52	<i>Philautus petersi</i> (Boulenger, 1900)	+				+				
53	<i>Philautus vermiculatus</i> (Boulenger, 1900)	+				+				
54	<i>Polypedates colletti</i> (Boulenger, 1890)	+				+				
55	<i>Polypedates leucomystax</i> (Gravenhorst, 1829)	+	+	+	+	+	+			+
56	<i>Polypedates macrotis</i> (Boulenger, 1891)	+		+		+		+		
57	<i>Rhacophorus appendiculatus</i> (Günther, 1858)	+				+				
58	<i>Rhacophorus nigropalmatus</i> Boulenger, 1895	+				+				
59	<i>Rhacophorus pardalis</i> Günther, 1858			+						
60	<i>Rhacophorus prominans</i> Smith, 1924	+		+		+				
61	<i>Rhacophorus norhayatae</i> Chan & Grismer 2010 [^]	+				+				
LACERTILIA (Lizards, geckos, skinks, varanids)										
Agamidae										
1	<i>Aphaniotis fusca</i> (Peters, 1864)	+		+		+		+	+	+
2	<i>Bronchocela cristatella</i> (Kuhl, 1820)			+					+	
3	<i>Gonocephalus bellii</i> (Duméril & Bibron, 1837)								+	
4	<i>Gonocephalus liogaster</i> (Günther, 1872)							+	+	

TABLE 3. CONTINUED.

No.	Family/Species	Grandison (1972)	Norsham et al. (2001)	Jasmi et al. (1999)	Salman et al. (1999)	Lim, B. L. 1999.	Grace (2006)	Chan et al. (2008)	Grismer (2011)	This study
5	<i>Draco abbreviatus</i> Hardwicke & Gray, 1827								+	
6	<i>Draco blanfordii</i> Boulenger, 1885								+	
7	<i>Draco fimbriatus</i> Kuhl, 1820	+				+			+	
8	<i>Draco formosus</i> Boulenger, 1887	+				+		+	+	
9	<i>Draco maximus</i> Boulenger, 1893	+				+			+	
10	<i>Draco melanopogon</i> Boulenger, 1887	+		+		+		+	+	+
11	<i>Draco fimbriatus</i> Kuhl, 1820	+				+				
12	<i>Draco quinquefasciatus</i> Hardwicke & Gray, 1827	+		+		+		+	+	
13	<i>Draco sumatranus</i> Schlegel, 1844	+		+		+		+	+	
14	<i>Pseudocalotes dringi</i> Hallermann & Böhme, 2000								+	
Varanidae										
15	<i>Varanus dumerilii</i> (Schlegel, 1839)									+
16	<i>Varanus nebulosus</i> (Gray, 1831)	+				+				
17	<i>Varanus rudicollis</i> (Gray, 1845)			+						
18	<i>Varanus salvator</i> (Laurenti, 1768)	+		+		+				+
Gekkonidae										
19	<i>Cnemaspis flavolineata</i> (Nicholls, 1949)	+				+			+	
20	<i>Cnemaspis kendallii</i> (Gray, 1845)	+				+			+	+
21	<i>Cyrtodactylus elok</i> Dring, 1979	+							+	
22	<i>Cyrtodactylus consobrinus</i> (Peters, 1871)	+				+		+	+	
23	<i>Cyrtodactylus quadrivirgatus</i> Taylor, 1962	+						+	+	+
24	<i>Cyrtodactylus brevipalmatus</i> (Smith, 1923)					+				
25	<i>Gehyra mutilata</i> (Wiegmann, 1834)	+				+			+	
26	<i>Gekko monarchus</i> (Schlegel, 1836)			+						
27	<i>Gekko smithii</i> Gray, 1842			+					+	
28	<i>Hemidactylus frenatus</i> Schlegel, 1836			+						
29	<i>Hemidactylus platyurus</i> (Schneider, 1792)			+					+	
Scincidae										
30	<i>Lipinia vittigera</i> (Boulenger, 1894)	+				+			+	+
31	<i>Eutropis multifasciata</i> (Kuhl, 1820)	+		+		+				+
32	<i>Sphenomorphus cyanolaemus</i> (Gray, 1835)	+				+			+	+
33	<i>Sphenomorphus indicus</i> (Gray, 1835)								+	
34	<i>Lygosoma bowringii</i> (Günther, 1864)			+						+
SNAKES										
Typhlopidae										
1	<i>Ramphotyphlops braminus</i> (Daudin, 1803)									+
2	<i>Typhlops mulleri</i> Schlegel, 1839	+				+				
Pythonidae										
3	<i>Malayopython reticulatus</i> (Schneider, 1801)			+		+				
Colubridae										
4	<i>Ahaetulla prasina</i> (Shaw, 1802)			+						
5	<i>Amphiesma sarawacensis</i> (Günther, 1872)	+				+				
6	<i>Boiga cynodon</i> (Boie, 1827)			+		+				
7	<i>Boiga drapiezii</i> (Boie, 1827)							+		
8	<i>Calamaria lumbricoidea</i> Boie, 1827	+				+				+
9	<i>Dendrelaphis formosus</i> (Boie, 1827)	+		+		+				
10	<i>Dryocalamus subannulatus</i> (Duméril, Bibron & Duméril, 1854)									+
11	<i>Coelognathus flavolineatus</i> (Schlegel, 1837)	+				+				
12	<i>Gonyophis margaritatus</i> (Peters, 1871)	+				+				
13	<i>Lepturophis albofuscus</i> (Duméril, Bibron & Duméril, 1854)	+				+				
14	<i>Gongylosoma baliodeirus</i> Boie, 1827	+				+				
15	<i>Gongylosoma longicauda</i> (Peters, 1871)	+				+				
16	<i>Lycodon subcinctus</i> Boie, 1827							+		

TABLE 3. CONTINUED.

No.	Family/Species	Grandison (1972)	Norsham et al. (2001)	Jasmi et al. (1999)	Salman et al. (1999)	Lim, B. L. 1999.	Grace (2006)	Chan et al. (2008)	Grismer (2011)	This study
17	<i>Macrocalamus jasoni</i> Grandison, 1972	+				+				
18	<i>Macropisthodon flaviceps</i> (Duméril, Bibron & Duméril, 1854)	+		+		+				
19	<i>Macropisthodon rhodomelas</i> (Boie, 1827)	+				+		+		
20	<i>Xenochrophis trianguligerus</i> (Boie, 1827)	+				+		+		
21	<i>Asthenodipsas malaccanus</i> Peters, 1864	+				+				
22	<i>Asthenodipsas vertebralis</i> (Boulenger, 1900)	+				+				
23	<i>Pseudorhabdion longiceps</i> (Cantor, 1847)	+				+				
24	<i>Ptyas korros</i> (Schlegel, 1837)			+						
Elapidae										
25	<i>Calliophis gracilis</i> Gray, 1835			+		+				
26	<i>Calliophis intestinalis</i> (Laurenti, 1768)	+		+		+		+		
27	<i>Bungarus flaviceps</i> Reinhardt, 1843	+				+				
28	<i>Naja sumatrana</i> (Müller 1890)			+						
Viperidae										
29	<i>Parias sumatranus</i> (Raffles, 1822)			+						
30	<i>Popeia fucata</i> (Vogel, Pauwels & David, 2004)	+				+				
31	<i>Tropidolaemus wagleri</i> (Boie, 1827)									
32	<i>Parias hageni</i> (Lidth de Jeude, 1886)	+				+				
33	<i>Trimeresurus wiroti</i> (Boie, 1827)	+								
TESTUDINES (Tortoises)										
Bataguridae										
34	<i>Heosemys spinosa</i> (Gray, 1830)									+

ACKNOWLEDGMENTS: We would like to thank the Department of Wildlife and National Parks for their collaboration and support in logistics and field assistants. We would also like to acknowledge our respective institutions for support in our researches. This research was partly funded by FRGS/1/2012/STWN10/UKM/02/4.

LITERATURE CITED

- Brown, R.M. and Guttman, S.L. 2002. Phylogenetic systematics of the *Rana signata* complex of Philippine and Bornean stream frogs: reconsideration of Huxley's modification of Wallace's Line at the Oriental-Australian faunal zone interface. *Biological Journal of the Linnean Society* 76: 393–461.
- Carranza, S. and E.N. Arnold. 2006. Systematics, biogeography, and evolution of *Hemidactylus* geckos (Reptilia: Gekkonidae) elucidated using mitochondrial DNA sequences. *Molecular Systematic Evolution* 38: 531–545.
- Chan, K.O., A. Norhayati and S. Juliana. 2008. Kekayaan spesies herpetofauna di Kuala Gandah menggunakan kaedah perangkap lubang berpagar; pp. 71–84, in: E. Sivananthan, Y. Siti Hawa, A.H. Abd Kadir, H. Hasdi, B.L. Lim, H. Rosli, A. Noorlidah, M.N. Shukor and I. Rahmah. (ed.). *Biodiversity Resources and Conservation Status in Peninsular Malaysia*. Malaysia: Department of Wildlife & National Parks.
- Chan, K.O. and L.L. Grismer. 2010. Re-assessment of the Reinwardt's Gliding Frog, *Rhacophorus reinwardtii* (Schlegel 1840) (Anura: Rhacophoridae) in Southern Thailand and Peninsular Malaysia and its re-description as a new species. *Zootaxa* 2505: 40–50.
- Che, J., J. Pang, H. Zhao, G.F. Wu, E.M. Zhao and Y.P. Zhang. 2007. Phylogeny of Raninae (Anura: Ranidae) inferred from mitochondrial and nuclear sequences. *Molecular Phylogenetics and Evolution*. 43: 1–13.
- David, P., G. Vogel, S.P. Vijayakumar and N. Vidal. 2006. A revision of the *Trimeresurus puniceus* – complex (Serpentes: Viperidae: Crotalinae) based on morphological and molecular data. *Zootaxa* 1293: 1–78.
- Das, I. 2004. *Lizards of Borneo*. Kota Kinabalu, Borneo: Natural History Publications. 83 pp.
- Das, I., N. Yaakob and J. Sukumaran, J. 2007. A new species of *Microhyla* (Anura: Microhylidae) from the Malay Peninsula. *Hamadryad* 31: 304–314.
- de Rooij, N. 1915. *The Reptiles of the Indo-Australian Archipelago*. I. *Lacertilia, Chelonia, Emydosauria*. Leiden: E. J. Brill. xiv + 384 pp.
- Frost, D.R., T. Grant, J. Faivovich, R.H. Bain, A. Haas, C.F.B. Haddad, R.O. De Sá, A. Channing, M. Wilkinson, S.C. Donnellan, C.J. Raxworthy, J.A. Campbell, B.L. Blotto, P. Moler, R.C. Drewes, R.A. Nussbaum, J.D. Lynch, D.M. Green and W.C. Wheeler. 2006. The amphibian tree of life. *Bulletin of the American Museum of Natural History* 297: 1–370.
- Frost, D.R. 2011. *Amphibian Species of the World: an Online Reference*. Version 5.5. Accessible at [http:// research.amnh.org /vz/ herpetology/amphibia/](http://research.amnh.org/vz/herpetology/amphibia/) American Museum of Natural History, New York, USA. Captured on 31 January 2011.
- Grace, R.L. 2006. Species diversity of Amphibia at Bukit Rengit, Krau Wildlife Reserve, Pahang. B.Sc. thesis. Bangi: Universiti Kebangsaan Malaysia. 31 pp.
- Grismer, L.L. 2011. *Lizards of Peninsular Malaysia, Singapore, and their Adjacent Archipelagos. Their Description, Distribution, and Natural History*. Frankfurt am Main: Chimaira Buchhandelsgesellschaft mbH. 728 pp.
- Grismer, L.L., K.O. Chan, N. Nurolhuda and M. Sumontha. 2008. A new species of karst dwelling gecko (genus *Cnemaspis* Strauch 1887) from the border region of Thailand and Peninsular Malaysia. *Zootaxa* 1875: 51–68.
- Grandison, A.G.C. 1972. The Gunung Benom Expedition, 1967: Reptilia and amphibians of Gunung Benom with a description of a new species *Macrocalamus*. *Bulletin of the British Museum of Natural History; Zoology* 23(4): 45–101.
- Haemamalar, K., M.S. Zailah and A. Neng Azhanie. 2010. Nutritional status of Orang Asli (Che Wong Tribe) adults in Krau Wildlife Reserve, Pahang. *Malaysian Journal of Nutrition* 16(1): 55–68.
- Jasmi, A., M.A. Shaari, Y. Norsham and B.L. Lim. 1999. Herpetofauna survey at Sungai Chenderoh, Perlok, Krau Wildlife Reserve, Pahang. *Journal of Wildlife and Parks* 17: 83–88.
- Lim, B.L. 1999. *Research activities of the fauna and flora at Krau Wildlife Reserve, Pahang, Peninsular Malaysia: A review*. Unpublished report. Kuala Lumpur: DANCED/DWNP KWR Project. 136 pp.
- Manthey, U. 2008. *Agamid Lizards of Southern Asia, Draconinae 1*. Münster: Aqualog Verlag. 160 pp.
- Matsui, M. 2009. A new species of *Kalophrynus* with a unique male humeral spine from Peninsular Malaysia (Amphibia, Anura, Microhylidae). *Zoological Science* 26: 579–585.

- Matsui, M., D. Belabut, N. Ahmad and H.-S. Yong. 2009. A new species of *Leptotalax* (Amphibia, Anura, Megophryidae) from Peninsular Malaysia. *Zoological Science* 26: 243–247.
- Matsui, M., Maryati, M., Shimada, T. and Sudin, A. 2007. Resurrection of *Staurois parvus* from *S. tuberinguis* from Borneo (Amphibia, Ranidae). *Zoological Science* 24(1): 101–106.
- Matsui, M., P. Yambun and A. Sudin. 2007. Taxonomic relationships of *Ansonia anotis* Inger, Tan, and Yambun, 2001 and *Pedostibes maculatus* (Mocquard, 1890), with a description of a new genus (Amphibia, Bufonidae). *Zoological Science* 24(11): 1159–1166.
- Norsham, Y. and A. Jasmi. 2000. Terrestrial herpetofauna. *Journal of Wildlife and Parks* 18: 21–38.
- Norsham, Y., T.M. Leong and L. Gary. 2001. Amphibians checklist of Bukit Rengit Lanchang, Pahang. *Journal of Wildlife and Parks* 19: 123–124.
- Ohler, A. and S. Grosjean. 2005. Color pattern and call variation in *Kalophrynus* from South-east (Anura: Microhylidae). *Herpetozoa* 18: 99–106.
- Inger, R.F., L.S. Bryan and T.I. Djoko. 2009. Systematics of a widespread southeast Asian frog, *Rana chalconota* (Amphibia: Anura: Ranidae). *Zoological Journal of the Linnean Society* 155: 123–147.
- Salman, S., A.P. Pazil and A. Sailun. 1999. A survey of the amphibians fauna in the Wildlife Training Centre, Lanchang at Krau Game Reserve, Pahang. *Journal of Wildlife and Parks* 17: 132–133.
- Shimada, T., M. Matsui, A. Sudin and M. Maryati. 2007. Identity of larval *Meristogenys* from a single stream in Sabah, Malaysia (Amphibia: Ranidae). *Zoological Journal of Linnean Society* 151: 173–189.
- Taylor, E.H. 1963. The lizards of Thailand. *University of Kansas Science Bulletin* 44: 687–1077.
- Wood, P.L. Jr., L.L. Grismer, A. Norhayati and S. Juliana. 2008. Two new species of torrent dwelling toads *Ansonia Stoliczka*, 1872 (Anura: Bufonidae) from Peninsular Malaysia. *Herpetologica* 64(3): 321–340.

RECEIVED: March 2013

ACCEPTED: February 2014

PUBLISHED ONLINE: May 2014

EDITORIAL RESPONSIBILITY: Olivier Pauwels