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RESEARCH NOTE

AMPHIBIAN OF TUPAH RECREATIONAL FOREST, MERBOK, KEDAH, MALAYSIA

SHAHRIZA, S*[1], IBRAHIM, J.[2] and SHAHRUL ANUAR, M.S.[3]

[1]*School of Pharmaceutical Sciences, Universiti Sains Malaysia*
11800 Penang, Malaysia
[2]*School of Distances Education, Universiti Sains Malaysia*
11800 Penang, Malaysia
[3]*School of Biological Sciences, Universiti Sains Malaysia*
11800 Penang, Malaysia
**E-mail: shahriza20@yahoo.com*

The state of Kedah with a total area of about 9,425 km^2, is located in northern Peninsular Malaysia, bordered by Perlis and Thailand in the north, Perak in the south and Penang in the southwestern. The topography, varied from lowland in the west to highland in the east. The two mountains ranges in Kedah are Banjaran Kedah-Singgora, located in the north and Banjaran Bintang Hijau in the east. Banjaran Bintang Hijau, the main upland system in the west coast of Peninsular Malaysia, arised from Bukit Besar, Thailand and extends to central Perak near Ipoh. Gunung (G.) Jerai (1214 m asl) is a mountainous system in Kedah is totally separated from Banjaran Bintang Hijau and located near the coastal area in the west, near Gurun. Several important rivers, such as Sungai (Sg.) Teroi, Sg. Lubuk Panjang, Sg. Gurun, Sg. Batu Pahat and Sg. Bujang arised from G. Jerai and flow to the lowland areas. There are many streams and waterfalls at the foothill of G. Jerai, such as Tupah waterfall, Seri Perigi waterfall, Sg. Batu Pahat, Batu Hampar and Titi Hayun that provide suitable environment for the amphibians to live and breed.

Several observation and collection of amphibian species had been done by scientists in various locations in Kedah such as Norhayati *et al.* (2005) at Ulu Muda, Ibrahim *et al.* (2006a) and Grismer *et al*. (2006) at Langkawi, Ibrahim *et al.* (2006b) at G. Jerai, Grismer *et al.* (2010) at Banjaran Bintang, Lim *et al*. (2010) at Langkawi, Shahriza *et al.* (2011a) at Lata Bukit Hijau, Shahriza *et al.* (2011b) at Beris Valley and Ibrahim *et al.* (2012a) at G. Inas. These surveys have produced many new species or new locality records, such as *Theloderma licin* (McLeod and Norhayati, 2007). Currently, this paper reporting the result of amphibian survey conducted much earlier that inhabit in Tupah Recreational Forest to complement the information on the distributions of amphibian species in Kedah.

Tupah Recreational Forest (5º 44'N/100º 27'E, < 200 m asl) (Figure 1) is located within Gunung Jerai Forest Reserve in Kuala Muda district. It is 6 km from Merbok and 18 km from Sg. Petani respectively. Sungai Bujang that originated from G. Jerai, flows through this recreational forest, into Sg. Merbok and empties into the Straits of Malacca. The survey on amphibian species was carried out between 1998 and 2001, totalling 10 nights of

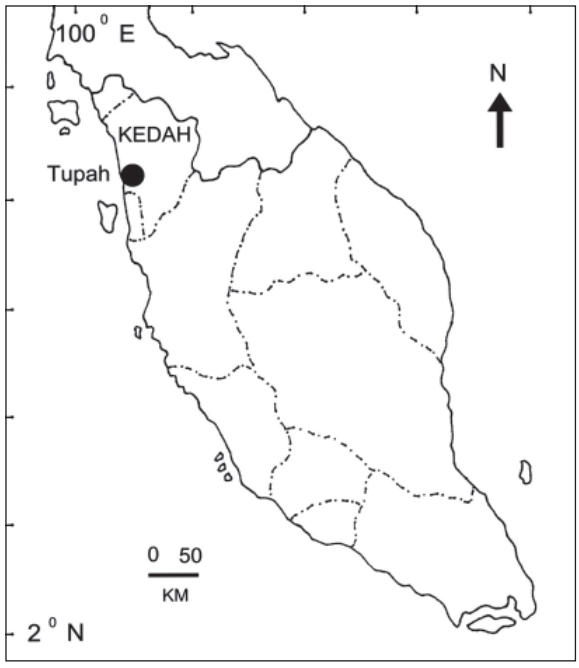

Fig. 1. Location of Tupah Recreational Forest, Merbok, Kedah.

* To whom correspondence should be addressed.

surveys. The sampling began from the water catchment area towards downstream about 300 m and also 1-3 m from the river bank. Within this area, the river was about 5-7 m wide, with clear crystal water and swift currents flowing in between boulders with sandy and gravel substrates. At the edge of the river there were many puddles, rain and rock pools that provided suitable breeding sites for some species of frogs such as *Fejervarya limnocharis, Microhyla heymonsi* and *M. butleri*. Both river banks were surrounded by lowland dipterocarp forests. The understorey was dominated by epiphytes, lianas, ferns and herbs, while the forest floors were covered by dead leaves and rotten logs.

Searching for amphibians were done at night (2000-2300 h) comprised of four persons using hand and sweep nets. The captured specimens were put into plastic aquarium and brought to the laboratory for identification. All frogs were identified according to Berry (1975) and the nomenclature followed by Frost (2011). The voucher specimens were fixed with 10% formalin, and later were stored in 70% ethanol before being deposited at Amphibians and Reptiles Collection, USM for future reference.

From the surveys, 13 species of frogs from eight genera and five families were found at Tupah Recreational Forest. This number is comparable to other studies on amphibian diversity in Northern Peninsular Malaysia. As for an example, Chan *et al.* (2010) listed 13 species in Pulau Pangkor, Perak; Ibrahim *et al*. (2011) reported 13 species in Bubu Permanent Forest Reserve, Perak; Shahriza *et al*. (2011a) reported 18 species in Lata Bukit Hijau, Kedah and Ibrahim *et al* (2012b) listed 15 species in Bukit Perangin Forest Reserve, Kedah. Amphibian checklist of Tupah Recreational Forest was shown in Table 1. Comparison of amphibian species between Ibrahim *et al*. (2006b) and this study were shown in Table 2.

Bufonidae

Only a single species of bufonid, *Phrynoidis aspera* was found during the survey. This species is very abundant and we found at average 27 individuals in each sampling period. Usually this riparian toads were found sitting on the big rock or under big boulders in the river but sometimes it can be found on the forest floors.

Table 1. Amphibian checklist of Tupah Recretional Forest, Merbok, Kedah

Taxa	Individual number											
	1998		1999		2000			2001				
	Jun	Sep	Apr	Oct	Feb	Jul	Dec	Mar	May	Jul	Total	RA (%)
Bufonidae												
Phrynoidis aspera	25	31	28	35	22	34	21	24	20	27	267	47.51
Dicroglossidae												
Fejervarya limnocharis	6	7	5	4	6	3	3	2	3	4	43	7.65
Limnonectes blythii	3	4	4	2	1	2	2	2	–	4	24	4.27
Limnonectes paramacrodon	–	1	1	2	–	2	–	1	–	–	7	1.25
Occidozyga laevis	–	–	1	3	–	1	–	–	–	1	6	1.07
Megophryidae												
Leptobrachium hendricksoni	–	L	2	4	1	–	L	L	1	L	8	1.42
Microhylidae												
Microhyla butleri	7	8	5	10	5	15	5	6	6	5	72	12.81
Microhyla heymonsi	5	12	7	6	7	6	6	5	3	4	61	10.85
Ranidae												
Hylarana erythraea	–	–	1	–	2	1	–	–	1	2	7	1.25
Hylarana glandulosa	1	1	3	2	4	3	2	–	2	3	21	3.74
Hylarana nicobariensis	–	–	–	1	–	1	–	–	–	1	3	0.53
Hylarana picturata	–	4	3	2	5	4	1	2	3	–	24	4.27
Rhacophoridae												
Polypedates leucomystax	–	2	3	5	1	4	–	2	–	2	19	3.38
Number of individual	47	70	63	76	54	76	40	44	39	53	562	100
Number of species	6	10	12	12	10	12	8	9	8	11	13	

Note: L = Larvae. RA = Relative Abundance (%).

Table 2. Comparison of amphibian species obtained from Gunung Jerai Forest Reserve

Taxa	Ibrahim *et al.* (2006)	This study
Bufonidae (3)		
Duttaphrynus melanostictus	+	–
Ingerophrynus parvus	+	–
Phrynoidis aspera	+	+
Dicroglossidae (6)		
Fejervarya limnocharis	+	+
Limnonectes blythii	+	+
Limnonectes macrodon	+	–
Limnonectes paramacrodon	–	+
Occidozyga laevis	–	+
Occidozyga sumatrana	+	–
Megophryidae (1)		
Leptobrachium hendricksoni	+	+
Microhylidae (2)		
Microhyla butleri	+	+
Microhyla heymonsi	+	+
Ranidae (7)		
Hylarana erythraea	–	+
Hylarana glandulosa	–	+
Hylarana nicobariensis	–	+
Hylarana nigrovittata	+	–
Hylarana picturata	+	+
Hylarana raniceps	+	–
Odorrana hosii	+	–
Rhacophoridae (1)		
Polypedates leucomystax	–	+

Note: + = Present. – = Absent

Dicroglossidae

Four species of frogs, *Fejervarya limnocharis, Limnonectes blythii, L. paramacrodon* and *Occidozyga laevis* representing the family Dicroglossidae. *F. limnocharis* (43 individuals) seems to be the most frequent species and mostly found at the car park, water catchment area and on the road. Several amplectant pairs of this species were also found in the small puddles near the edge of the river after heavy rain. *L. blythii* and *L. paramacrodon* were encountered along the river banks, hiding under rocks, drift woods or tree buttress. *O. laevis* usually found in the puddles or rock pools near the river.

Megophryidae

Only one species of megophryid, *Leptobrachium hendricksoni* was recorded during the survey. Most of this species were found hiding under dead leaves, under rotten wood, under rocks and beside tree buttress. We also found the large and heavy bodied tadpoles of this species hiding under drift leaves in the river with slow moving current.

Microhylidae

Two microhylids species**,** *Microhyla butleri* and *M. heymonsi* were recorded during the survey. These common species were found in every sampling period with an average of seven and six individuals. Both species were usually spotted hiding under tall grass and leaf litter near the car park, in the rain pools and puddles. The calling activities by the males of these two species were really active especially after heavy rain. We also found the tadpoles of both species in the shallow puddles that accumulated with dead leaves near edge of the river.

Ranidae

Four species of ranids, *Hylarana erythraea, H. glandulosa, H. nicobariensies* and *H. picturata* were encountered during the survey. The Green Paddy frog, *H. erythraea* were found in the ditches near the water catchment area, in the puddles and rock pools near the river. The Rough-Side frog, *H. glandulosa* were usually found in the marsh areas and along the river banks. We also heard several calling males (at least four to six individuals in each sampling period) crocking from the marsh areas in the late evening (1700 h) until early night (2000 h). The Spotted Stream frog, *H. picturata* usually found perching on twig (< 0.5 m above ground), sitting on big boulders, under drift wood and on forest floor along the river banks. As for *H. nicobariensis,* we spotted this species hiding under grass and leaf litter near the puddles and rock pools. Only three individuals of *H. nicobariensis* were found during the survey.

Rhacophoridae

Only a single rhacophorid species, *Polypedates leucomystax* was found during the observation period. This species was encountered near the water catchment area, in the toilet and small bush near the car park. We also found their foam nests and tadpoles in a temporary puddles and rock pools at the edge of the river.

All frog species that encountered during the study period were forest frogs except the five commensal species namely *F. limnocharis, H. erythraea, P. leucomystax, M. butleri* and *M. heymonsi*. The present of both commensal and forest frog indicated the area was already disturbed by human but in minimal condition. Various forest frog species such as *P. aspera* (267 individuals), *L. blythii* (24 individuals), *H. picturata* (24 individuals) and *H. glandulosa* (21 individuals) were recorded from this area and it indicated that the river and their surrounding areas are clean and unpolluted. According to Ibrahim *et al*. (2006b) some species of frogs such as *H. picturata, Hylarana raniceps, L. blythii* and *Limnonectes macrodon* can only thrive in clean and clear-flowing water. In addition, the

presence of streams, freshwater marshes, puddles and rock pools around the area provided a suitable site for the anurans to breed. Amphibians breed in a variety of water bodies and almost half of all frog species in Malaysia breeds in the streams and rivers (Inger, pers. comm.).

Previous studies by Ibrahim *et al.* (2006b), reported nine species of frogs inhabiting the lower and 10 species inhabiting the upper part of G. Jerai. This study was focussed on lower part of G. Jerai and all the nine species that mentioned by Ibrahim *et al.* (2006b) were found here, except for *Ingerophrynus parvus*, *H. raniceps* and *L. macrodon.* The absent of these species during our observation presumably due to the different study sites. Ibrahim *et al.* (2006b) surveyed an amphibian species on three different rivers, Sg. Teroi and Sg. Badak at the north and Sg. Lubuk Panjang at the west while our study was highlighted on Sg. Bujang that located at the south of G. Jerai. According to Inger (1969), the presence or absence of a riparian species is as likely to be determined by the physical characteristics of a stream as by the presence of ecologically related species. Thus, the physical characteristics of the stream determine the success of particular ecological types, each of which may include a number of species (Inger, 1969).

All 10 species of frogs that mentioned by Ibrahim *et al*. (2006b) inhabiting the upper part of G. Jerai were present in our study except for *Duttaphrynus melanostictus, Occidozyga sumatrana, H. raniceps, L. macrodon, Hylarana nigrovittata* and *Odorrana hosii*. These species were not specialized at upland habitats and can be easily found at lowland areas (Berry, 1975; Das, 2007; Norhayati *et al.*, 2009). Ibrahim *et al.* (2006b) also mentioned the finding of *O. sumatrana* from Sg. Teroi and Sg. Badak at the upper part of G. Jerai. After examined back the specimen, we suggested the species was *O. laevis,* but it was not confirmed yet until the DNA analysis was done. From previous documentation, *O. sumatrana* can only be found in Sumatera, Java and Mentawai island of Indonesia and no record of occurrence this species in Peninsular Malaysia (IUCN, 2011). Another species mentioned by Ibrahim *et al*. (2006b) is *H. raniceps* that found both at lower and upper part of G. Jerai. According to Inger *et al*. (2009) this species was only found in Borneo and the species that occurred in Peninsular Malaysia referred to *Rana labialis*. Based from this fact, the species from G. Jerai that mentioned by Ibrahim *et al.* (2006b) could be *R. labialis,* but again was not confirm yet until DNA analysis was done. Both species are very similar in morphology and colour pattern but molecular analysis showed the differences between them (Inger *et al.*, 2009). From this surveyed the number of amphibian species from Gunung Jerai Forest Reserve was increased from 14 (Ibrahim *et al.,* 2006b) to 20 species. The six new records were *H. erythraea, H. glandulosa, H. nicobariensis, L. paramacrodon, O. laevis* and *P. leucomystax.*

Study on herpetofauna in Tupah Recreational Forest is still ongoing and we hope to discover and recorded more species of amphibians in the next few years. This study is important to understand the population and distribution of amphibian in Northern Peninsular Malaysia especially in Kedah.

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