

Amphibian Biodiversity of Gunung Inas Forest Reserve, Kedah, Malaysia

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ABSTRACT

A study on the biodiversity of frogs and toads from Compartment 15 of Gunung Inas Forest Reserve, Kedah, was carried out for a 6 month period, beginning August 2008 till end of January 2009. Samplings were conducted once a month comprising a total catch effort of about 85 man-hours. Positive identification of specimens follows that of Berry (1975), Sukumaran (2006) and Norhayati *et al.*, (2009). Twenty-eight species of anurans from six families were found to inhabit the site. The two most abundant species were *Amolops larutensis* and *Phrynooidis aspera*. Thirteen species namely *Megophrys nasuta*, *Leptobrachium hendricksoni*, *Duttaphrynus melanostictus*, *Limnonectes malesianus*, *Limnonectes laticeps*, *Limnonectes plicatellus*, *Hylarana doriae*, *Hylarana erythraea*, *Hylarana luctuosa*, *Humerana miopus*, *Hoplobatrachus rugulosus*, *Rhacophorus tunkui*, and *Nyctixalus pictus* were considered rare. The Shannon-Wiener Diversity Index (H') was low at 0.745, while the Evenness Index (J) was low with the value of 0.149. The presence of clean water species, such as *Hylarana luctuosa*, *Hylarana labialis*, *Odorrana hosii*, and *Phrynooidis aspera* showed that the habitat at Compartment 15 of Gunung Inas Forest Reserve was largely undisturbed and pristine. It is hoped that future development of the site into a recreational facility does not degrade the uncontaminated riparian ecosystem that is essential for amphibian survival.

Keywords: Amphibians, biodiversity, primary forest, Gunung Inas, Malaysia

INTRODUCTION

The amphibian fauna of Peninsular Malaysia is rich in biodiversity, comprising 4 caecilians and about 88 frog species and toads from 5 families, namely Megophryidae, Bufonidae, Rhacoporidae, Ranidae and Microhylidae (Berry, 1975; Kiew, 1984). In Borneo, there are 138 species of amphibian which consist of anuran only (Inger & Tan, 1996). Research by Ramlah (2002) in Sedilu Mangrove Forest Reserve, Sarawak found 11 species of frogs. The research resulted in low diversity in Sedilu mangrove Forest Reserve ($H=2.40$).

The most dominant species in the area were *Rana baramica*, *Limnonectes paramacrodon*, *Occidozyga laevis*, and *Bufo quadriporcatus*. Das (2006) found 59 anuran species from 5 families at the Crocker Range in Sabah and most of them are montane species. Another research conducted by Ibrahim *et al.*, (2006) in Gunung Jerai, Kedah yielded 85 individuals from 14 species in 4 families.

Populations of amphibians and reptiles are declining due to among others, habitat degradation, pollution, deforestation and diseases (Doherty-Bone, 2008) and Ibrahim *et al.*, (2006) and Kiew (1984) reported that

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forest frog species are threatened by logging and development, and are thus, vulnerable to extinction. This is especially so since of late, a tremendous increase of deforestation has been noticed to occur in Peninsular Malaysia. Forest cover has fallen dramatically in Malaysia since the 1970s. While Food and Agriculture Organization (FAO) says that forests still cover more than 60% of the country, only 11.6% of these forests are considered pristine (Butler, 2005). Hence, it is vital that we undertake basic studies on amphibian numbers and populations before the force of progress and development push these creatures into oblivion. Other than inventories, checklists and surveys, very little information is available on the amphibian fauna in Malaysia, but we do need to do this kind of studies first before we can shift to other aspects of their ecology. Therefore, this paper reports on the diversity of amphibians found in Compartment 15 of Gunung Inas Forest Reserve as baseline data for future studies of amphibians in the general vicinity.

MATERIALS & METHOD

Study Site

Compartment 15 of Gunung Inas Forest Reserve is located at $5^{\circ} 32' 60''$ N and $100^{\circ} 35' 60''$ E with elevation 100m above sea level. It is situated 30 km due east of Kulim, Kedah. The forest coverage is about 36 979 ha. The study area is a lowland dipterocarp forest, which is a very suitable habitat for a diverse amphibian fauna to thrive. A fast flowing, rocky river, Sungai Sedim, flows through the compartment arising from Gunung Inas and emptying into Sg. Muda. Among the dominant plant species here are *Shorea curtisii* (Dark Red Meranti), *Shorea leprosula* (Red Meranti), *Shorea macroptera* (Light Red Meranti), *Scorodocarpus borneensis* (Bawang Hutan), *Artocarpus lanceifolius* (Keledang) and *Callophyllum* spp. (Bintangor). The dense vegetation on the forest floor and the presence of Sungai Sedim are ideal for certain species of frogs that breed in the streams. There are a lot of activities and

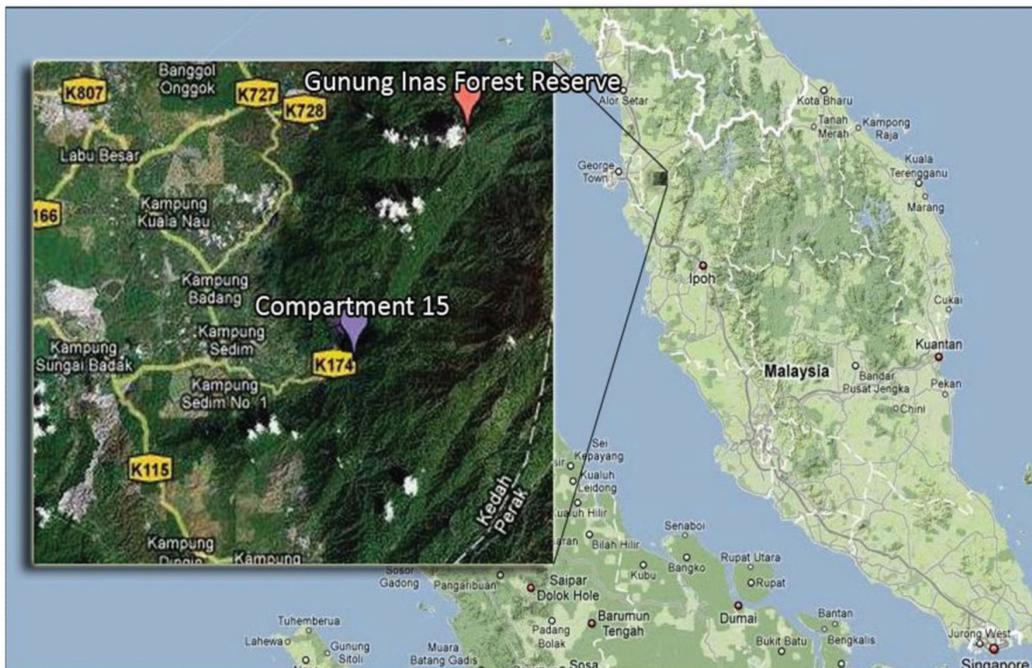


Fig.1: Location of Compartment 15, Gunung Inas Forest Reserve, Kedah, Malaysia, ($5^{\circ} 32' 60''$ N, $100^{\circ} 35' 60''$ E). Source: Google maps (2010).

projects running now in Gunung Inas Forest Reserve such as Sedim Recreational Forest that comprises chalets, hostels and tourists attraction the Tree Top Walk. Among the activities there are picnics, camping, jungle trekking, water rafting and kayaking.

Sampling Method

Samplings were done during night time and specimens were caught by using net or by hand. Field parties comprising 5-6 persons scour along 200m of the riparian zone of Sungai Sedim and along trails in the forest from 2000h to 2200h. When captured, frogs were placed in individual plastic bags and transported to laboratory for processing where the morphometric data of individuals for every species was recorded. Frogs were identified by referring to Berry (1975), Sukumaran (2006) and Norhayati *et al.*, (2009). The data were analyzed by using various statistical methods including Shanon-Wiener Index for species diversity, Menhinick Index and Margalef Index for species richness, Evenness Index, and Simpson Index for species dominance (Khang, (2006)).

Man-hour calculation:
 Number of individual x total of hours =
 Man-hours

RESULTS AND DISCUSSION

A total of 932 anuran specimens comprising 28 species from six families were collected during the study, (Table 2).

The two most abundant species were *Amolops larutensis* and *Phrynooidis aspera*. These two species were all collected along the riparian zone of Sungai Sedim River. The value for Margalef Index (M=10.44) and Menhinick Index (1.04 is significantly high and thus prove that the study area is rich with anuran species. The value for Shannon-Wiener Index is 0.75 and the value of H'max is 5 which shows that the area has a low diverse anuran community. This low H'value (low diversity) is due to the high number of individuals of the species *Amolops larutensis* and *Phrynooidis aspera* and they skewed the analysis of Shannon-Wiener index towards the low side The value for Evenness Index (J) is low at 0.15. The value of Simpson index is 0.31 which indicates low species dominance in Compartment 15. Thus from statistical analysis we can conclude that the amphibian assemblage at Compartment 15 Gunung Inas Forest Reserve has a high species richness, low species diversity, and low species evenness. The most abundant species are *Amolops larutensis* with 514 individuals

TABLE 1
 Man-hours calculation.

No. of individual involved	Total number of hours	Total hours x man-power
6	1 hour	6 hours
4	1 hour 15 minutes	5 hours
6	1 hour 55 minutes	11 hours 30 minutes
5	2 hours 5 minutes	10 hours 25 minutes
5	2 hours 20 minutes	11 hours 40 minutes
4	1 hour 15 minutes	5 hours
1	1 hour	1 hour
2	1 hour 10 minute	2 hours 20 minutes
2	3 hours	6 hours
7	2 hours	14 hours
5	2 hours 25 minutes	12 hours 5 minutes
Total hours of sampling		85 man-hours

TABLE 2
List of species and number of individuals collected.

No	Family	Species	Common name	Total
1	Megophryidae	<i>Megophrys nasuta</i>	Malayan Horned Frog	1
		<i>Leptobrachium hendricksoni</i>	Spotted Litter Frog	33
2	Bufonidae	<i>Pedostibes hosii</i>	Yellow Spotted Tree Toad	5
		<i>Ingerophrynus parvus</i>	Dwarf Lesser Toad	20
		<i>Duttaphrynus melanostictus</i>	Common Sunda Toad	3
		<i>Phrynoidis aspera</i>	Giant River Toad	216
3	Dicroglossidae	<i>Fejervarya limnocharis</i>	Paddy Frog	13
		<i>Fejervarya cancrivora</i>	Crab-eating Frog	9
		<i>Limnonectes plicatellus</i>	Rhinoceros Frog	3
		<i>Limnonectes blythii</i>	Blyth's Giant Frog	9
		<i>Limnonectes malesianus</i>	Peat Swamp Frog	2
		<i>Limnonectes laticeps</i>	Flat-Headed Frog	1
		<i>Occidozyga laevis</i>	Yellow-bellied puddle Frog	17
		<i>Occidozyga lima</i>	Green Puddle Frog	8
4	Microhylidae	<i>Microhyla heymonsi</i>	Taiwan Rice Frog	9
5	Ranidae	<i>Hylarana erythraea</i>	Green Paddy Frog	8
		<i>Hylarana luctuosa</i>	Mahogany Frog	1
		<i>Hylarana nicobariensis</i>	Cricket Frog	4
		<i>Hylarana labialis</i>	White-lipped Frog	10
		<i>Hylarana doriae</i>	Doria's Frog	1
		<i>Humerana miopus</i>	Diagonal-lined Frog	2
		<i>Hoplobatrachus rugulosus</i>	Chinese Edible Frog	1
		<i>Amolops larutensis</i>	Larut Torrent Frog	514
		<i>Odorrana hosii</i>	Poison Rock Frog	35
		<i>Odorrana monjerai</i>	Mount Jerai Frog	15
6	Rhacophoridae	<i>Polypedates leucomystax</i>	Common Tree Frog	16
		<i>Rhacophorus tunkui</i>	Tunku's Tree Frog	8
		<i>Nyctixalus pictus</i>	Cinnamon Tree Frog	1
Total				932

TABLE 3
Habitat of amphibians found in Gunung Inas Forest Reserve

No	Species	Location (Habitat)	Sizes
1	<i>Megophrys nasuta</i>	Found on the forest floor or rocks where they blend in well with dead leaves	70-105mm (males); 90-125mm (females)
2	<i>Leptobrachium hendricksoni</i>	Found on the ground, on jungle trails and road cuts. (mostly under leaf-litters)	39-48mm (males); 52-80mm (females)
3	<i>Pedostibes hosii</i>	Found on tree branches and on rocks	53-80mm (males); 89-105mm (females)
4	<i>Ingerophrynus parvus</i>	Found along riverbanks of small stream to rivers and along the forest tracks.	Up to 52 mm
5	<i>Duttaphrynus melanostictus</i>	Found mostly at disturbed area and human settlements.	57-83mm (males), 65-85mm (females)
6	<i>Phrynoidis aspera</i>	Found along river trails and also in jungle trails.	70-100mm (males), 95-140mm (females)
7	<i>Fejervarya limnocharis</i>	Found in disturbed area (example: villages, paddy field and garden)	32-50mm (males); 48-60mm (females)
8	<i>Fejervarya cancrivora</i>	Found along the coast, lower reaches of large river basins, semi brackish, swampy areas close to the sea or in freshwater swamps beyond tidal influence.	51-70mm (males); 53-82mm (females)
9	<i>Limnonectes plicatellus</i>	Found in lowland swamp forest areas with small rivers and streams.	35-43mm (males); 29-34mm (females)
10	<i>Limnonectes blythii</i>	Found along rivers and streams in lowland forests but can also be found in disturbed areas and hill forests.	90-260mm (males); 85-125mm (females)
11	<i>Limnonectes malesianus</i>	Found along jungle trails and disturbed forests.	70-150mm (males); 75-95mm (females)
12	<i>Limnonectes laticeps</i>	Found along river trails and small streams.	24-47mm (males); 32-46mm (females)
13	<i>Occidozyga laevis</i>	Found in shallow pools and puddles in lowland forests and slightly disturbed areas.	(26-62mm)
14	<i>Occidozyga lima</i>	Found in shallow pools and puddles in lowland forests and slightly disturbed areas.	(20-25mm)
15	<i>Microhyla heymonsi</i>	Found in cleared areas and disturbed forests on low bushes on the ground among grasses, shrubs and other vegetation.	16-21mm (males); 22-26mm (females)
16	<i>Hylarana erythraea</i>	Found in rice fields, disturbed areas and swampy areas.	30-45mm (males); 50-75mm (females)
17	<i>Hylarana luctuosa</i>	Found on rocks, steep banks or low vegetation very near flowing waters of clear upland rivers.	41-59mm (males); 42-60mm (females)
18	<i>Hylarana nicobariensis</i>	Found in swampy areas of lowland secondary forests or at disturbed areas.	37-47mm (males); 47-53mm (females)
19	<i>Hylarana labialis</i>	Found in forest streams and swamps.	37-48mm (males); 44-71mm (females)

Table 3 (continued)

20	<i>Hylarana doriae</i>	Found moist lowland forests, subtropical or tropical moist montane forests, and rivers.	70-150mm (males); 75-95mm (females)
21	<i>Humerana miopus</i>	Found at forest floor in swampy areas.	(71-73mm)
22	<i>Hoplobatrachus rugulosus</i>	Found in swampy areas and paddy fields.	(84-77mm)
23	<i>Amolops larutensis</i>	Found along forest streams and rivers and usually on rocks.	35-45mm (males); 53-75mm (females)
24	<i>Odorrana hosii</i>	Found on rocks, steep banks or low vegetation near flowing waters.	45-63mm (males); 85-100mm (females)
25	<i>Odorrana monjerai</i>	Found along clear, moderate to swift flowing forest streams and waterfalls in lowland or upperhill forests.	75mm (females); 38-43mm (males)
26	<i>Polypedates leucomystax</i>	Found near human settlements, disturbed areas, and near water bodies (if breeding).	37-50mm (males); 57-75mm (females)
27	<i>Rhacophorus tunkui</i>	Found in lowland forests, on leaves or branches surrounding puddles and forest ponds.	up to 42 mm
28	<i>Nyctixalus pictus</i>	Found in primary and secondary forest as well as slightly disturbed habitats, on leaves and branches of small trees low to the ground	Up to 33 mm (males); up to 38mm (females)

TABLE 4
Comparison of amphibian diversity in Northern Malaysia.

No. of Species	Locality	Source
26	Island of Penang	Ibrahim <i>et al.</i> (2008)
19	South Kedah	Shahriza (2007)
16	Island of Langkawi, Kedah	Ibrahim <i>et al.</i> (2006)
24	Island of Langkawi, Kedah	Grismer <i>et al.</i> (2006)
56	Ulu Muda Forest Reserve, Kedah	Norhayati <i>et al.</i> (2005)
36	Ulu Muda Forest Reserve, Kedah	Norsham <i>et al.</i> (2005)
13	Wang Kelian State Park, Perlis	Ibrahim <i>et al.</i> (2001)
9	Belum Forest Reserve, Perak	Norsham <i>et al.</i> (2000)
24	Temenggor Forest Reserve, Perak	Kiew <i>et al.</i> (1995)
28	Gunung Inas Forest Reserve	This Study

TABLE 5
Relative abundance of amphibians in Compartment 15 of Gunung Inas Forest Reserve

No	Species	Common Name	Relative Abundance (%)
1	<i>Megophrys nasuta</i>	Malayan Horned Frog	0.1
2	<i>Leptobrachium hendricksoni</i>	Spotted Litter Frog	3.5
3	<i>Pedostibes hosii</i>	Yellow Spotted Tree Toad	0.5
4	<i>Ingerophrynus parvus</i>	Dwarf Lesser Toad	2.2
5	<i>Duttaphrynus melanostictus</i>	Common Sunda Toad	0.3
6	<i>Phrynoidis aspera</i>	Giant River Toad	22.5
7	<i>Fejervarya limnocharis</i>	Paddy Frog	1.4
8	<i>Fejervarya cancrivora</i>	Crab-eating Frog	1.0
9	<i>Limnonectes plicatellus</i>	Rhinoceros Frog	0.3
10	<i>Limnonectes blythii</i>	Blyth's Giant Frog	1.0
11	<i>Limnonectes malesianus</i>	Peat Swamp Frog	0.2
12	<i>Limnonectes laticeps</i>	Flat-Headed Frog	0.1
13	<i>Occidozyga laevis</i>	Yellow-bellied puddle Frog	1.8
14	<i>Occidozyga lima</i>	Green Puddle Frog	0.9
15	<i>Microhyla heymonsii</i>	Taiwan Rice Frog	1.0
16	<i>Hylarana erythraea</i>	Green Paddy Frog	0.9
17	<i>Hylarana luctuosa</i>	Mahogany Frog	0.1
18	<i>Hylarana nicobariensis</i>	Cricket Frog	0.4
19	<i>Hylarana labialis</i>	White-lipped Frog	1.1
20	<i>Hylarana doriae</i>	Doria's Frog	0.1
21	<i>Humerana miopus</i>	Diagonal-lined Frog	0.2
22	<i>Hoplobatrachus rugulosus</i>	Chinese Edible Frog	0.1
23	<i>Amolops larutensis</i>	Larut Torrent Frog	55.2
24	<i>Odorrana hosii</i>	Poison Rock Frog	3.8
25	<i>Odorrana monjerai</i>	Mount Jerai Frog	1.6
26	<i>Polypedates leucomystax</i>	Common Tree Frog	1.7
27	<i>Rhacophorus tunkui</i>	Tunku's Tree Frog	0.9
28	<i>Nyctixalus pictus</i>	Cinnamon Tree Frog	0.1
Total			100

followed by *Phrynoidis aspera* with 216 individuals. The presence of clean water species such as *Hylarana luctuosa*, *Hylarana labialis* and *Odorrana hosii* shows that the habitat at compartment 15 of Gunung Inas Forest Reserve is largely undisturbed and pristine. Even as we were conducting the study, the state government, in cooperation with the Ministry of Tourism, Malaysia, is developing the area into a large recreational facility by building chalets, roads and parking areas in the vicinity. The beautiful Cinnamon Tree Frog (*Nyctixalus pictus*) which is classified as near threatened under the IUCN 'Red List' status is also found here, as well as 3 other near threatened species, namely *Limnonectes Blythii*, *Limnonectes malesianus* and *Rhacoporus tunkui*. It is imperative that Gunung Inas Forest Reserve be preserved in its pristine state since it harbours a good number of amphibian species. This forest reserve and others adjacent to it such as Ulu Muda Forest Reserve to the north and Bintang Hijau Forest Reserve to the south are rich in amphibian species (Norhayati *et al.*, 2005). It is hoped that the future development of the site into a recreational facility does not compromise or degrade the uncontaminated ecosystem that is essential for amphibian survival and existence since they are known to play important roles in the ecological processes of the tropical forest ecosystem.

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