
Research Article

Diversity of Herpetofauna in Kadamaian, Kota Belud, Sabah, MalaysiaAnna Wong @ Wong Yun Moi¹, Nur Syamimi Makbul^{2*}, Paul Yambun³¹*Faculty of Tropical Forestry, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah*²*Malaysian Nature Society, JKR 641, Jalan Kelantan, Bukit Persekutuan, 50480 Kuala Lumpur, Malaysia*³*Research and Education Division, Zoology Unit, Kinabalu Park, PO Box 10626, Kota Kinabalu, 88806, Sabah, Malaysia****Corresponding author:** mimimakbul@yahoo.com**Abstract**

A survey on amphibians and reptiles or herpetofauna in Kadamaian, Kota Belud was carried out on 21st to 25th October, 2019 during the Borneo Geographic Expedition jointly organized by the Institute for Tropical Biology and Conservation (ITBC) of Universiti Malaysia Sabah (UMS) and Sabah Parks. The main purpose of the survey is to update the list of herpetofauna in the study area. Visual Encounter Survey (VES) method was applied and transects were established at the waterfall near the expedition base camp, Pinolobu River, Kipungit River in Melangkap Noriou and Meliawa River, resulting in 15 species of amphibians from five families and six species of reptiles from three families recorded. Significantly, the survey recorded 10 species of herpetofauna that are endemic to Borneo, including one Endangered (EN) frog species namely *Leptobranchella sabahmontana* of the family Megophryidae and one new record for Sabah which is *Ansonia minuta* of the family Bufonidae. Two reptiles out of the recorded list were Bornean endemics namely *Cyrtodactylus baluensis* and *Tropidophorus micropus*. *Fejevarya limnocharis* and *Polypedates leucomystax* seemed to be the common species of amphibians recorded whereas *Eutrophis rudis* was the common reptile species found in the area. The result, in term of species number was low especially for reptiles due to the short survey period. However, this report managed to update the list for herpetofauna species in Kadamaian, Kota Belud. Nevertheless, this study contributes to Borneo's herpetofauna database specifically in Sabah and serves as reference for more studies and research in future.

Keywords: Herpetofauna, Amphibians, Reptiles, Kadamaian, Kota Belud, Sabah, Visual Encounter Survey**Introduction**

Herpetofauna is defined as amphibians and reptiles in a particular region, habitat or geological period and Borneo's tropical rainforest is home to a variety of this group. Inger et al., (2017) documented over 180 species of frogs in

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Borneo, of these 139 are endemic to the island and about 100 species had been recorded in Sabah whereas there were about 289 species of reptiles that have been recorded in Borneo (Das, 2006). Amphibians and reptiles inhabit diverse types of environments including disturbed areas, mangroves, rivers, streams, swamps, waterfalls, lakes, primary forests, plantations, caves and mountains (Shahriza Shahrudin et al., 2011). In tropical forests, amphibians may utilize a wide range of microhabitat types such as rocky streams, hilly terrain and non-riparian forested area (Inger et al., 2002; Pui & Das, 2016).

The hilly sub-montane and montane forests of Mount Kinabalu are home to 77 species of amphibians and 112 species of reptiles. They are found in various environments or microhabitats such as trees at various storeys, leaf-littered forest floor and habitats dominated by mountain streams (Malkmus et al., 2002). Mount Kinabalu which is situated within the Kinabalu Park, is one of the most crucial water catchments in Sabah and many streams originate from the massif including Kadamaian River that flows to the west. As a protected area, several studies or surveys related to herpetofauna have been performed in Mount Kinabalu and its herpetofauna diversity is well-documented compared to areas outside the park especially within its buffer zone. Thus, it would be interesting to explore the environments beyond the border of the protected area.

To date, so far data or records on herpetofauna in Kadamaian have been documented in a miscellaneous collection of publications, i.e in Malkmus et al., (2002). Therefore, this study aims to record amphibians and reptiles that occur in Kadamaian and to update the list of herpetofauna in the area.

Methods

Study site

Kadamaian area is located in Kota Belud District within the west coast of Sabah and the study site (N 06° 12'25.6" E 116° 30'34.1") borders Kinabalu Park at the eastern part (Figure 1). This survey was conducted for a period of five days, from 21st to 25th October, 2019 during the Borneo Geographic Scientific Expedition in Kadamaian - Kinabalu Park which was jointly organized by the Institute for Tropical Biology and Conservation (ITBC) of Universiti Malaysia Sabah (UMS) and Sabah Parks. The expedition base camp was located at an elevation of approximately 600 meters above sea level (m a.s.l). The Kadamaian expedition area comprised of hill submontane forest type and montane forest with the elevation ranging from 500 to 1430m a.s.l, with the highest elevation being Mount Nopungguk (Figure 2).

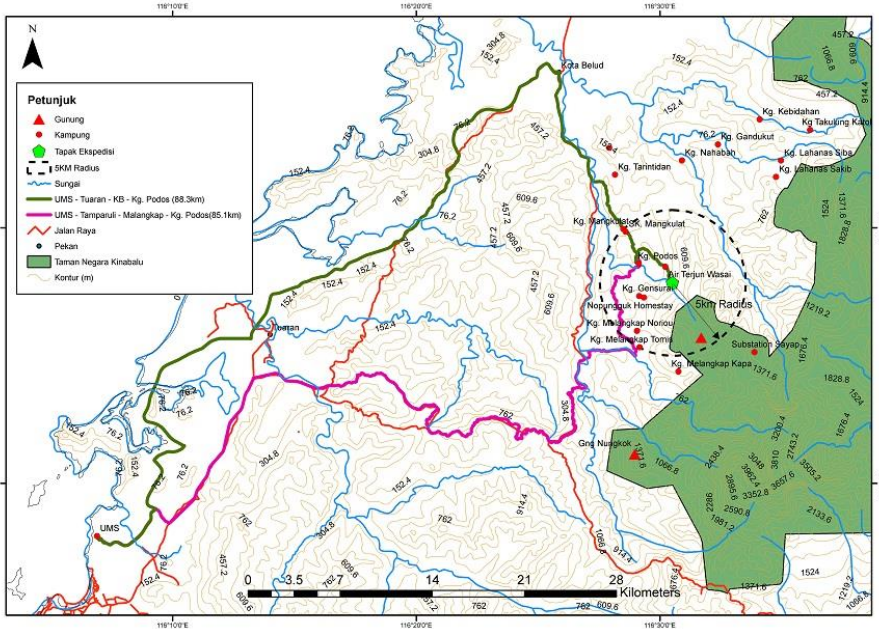


Figure 1. The Borneo Scientific Expedition site map in Kadamaian, Kota Belud which borders Kinabalu Park and a small part of the park included in the scientific expedition study area (Source: ITBC, UMS).

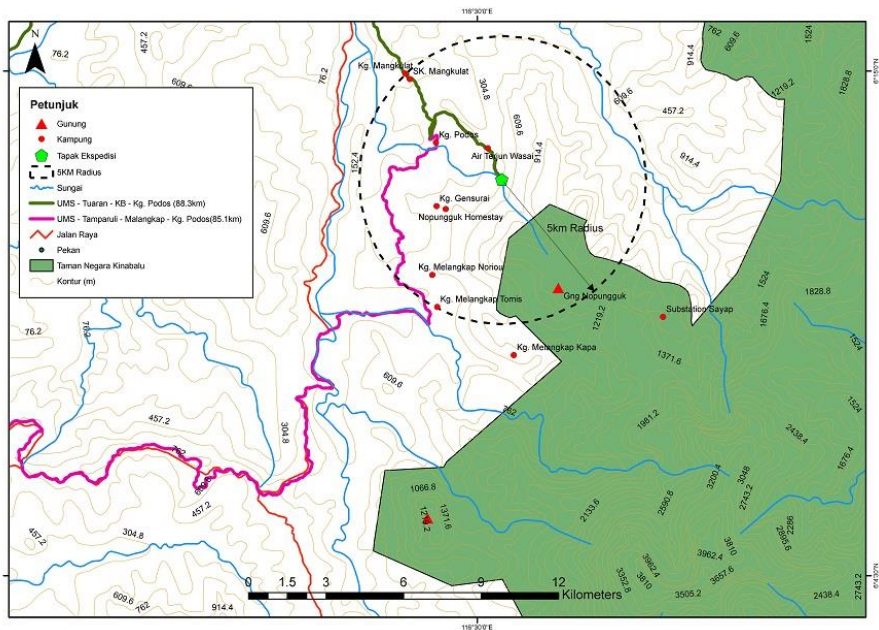


Figure 2. Topography Map of the study area (Source: ITBC, UMS)

Four localities were selected namely the waterfall near the base camp, Pinolobu River, Kipungit River in Melangkap Noriou and Meliawa River at the base camp. All localities comprise of riparian forests within 300-700m a.s.l., and night transects were established along the riparian area. Only localities near the base camp namely waterfall and Meliawa River can be considered as good forests. Meanwhile, localities adjacent to human settlements are old secondary forests or have been converted into rubber tree plantations. Samplings were conducted at 1900 hour until 2200 hour and Visual Encounter Survey (VES) method was applied. Photos of the captured herpetofauna were taken before release for documentation and identification. Global Positioning System (GPS), Garmin device was used to mark the coordinates and the 'A field guide to the Frogs of Borneo' book by Inger et al., (2017) was referred for identification purpose.

Results and Discussion

Overall, a total of 15 species of amphibians from five families and six species of reptilians from three families were found inhabiting the study area (Table 1). The recorded frogs were *Ansonia minuta*, *Ansonia spinulifer* and *Ansonia longidigata* from the family Bufonidae (20%); *Staurois guttatus*, *Meristogenys poecilus*, *Huia cavitympanum* and *Hylarana picturata* from the family Ranidae (26.7%); *Limnonectes kuhlii* and *Fejevaryia limnocharis* from the family Dicroglossidae (13.3%); *Leptolalax gracilis*, *Leptobrachella sabahmontana* and *Leptobrachium abbottii* from the family Megophryidae (20%); and *Philautus hosii*, *Polypedates leucomystax* and *Polypedates macrotis* from the family Rhacophoridae (20%). Meanwhile, the six reptiles were *Gonocephalus liogaster* and *Branchocela cristatella* from the family Agamidae (33.3%); *Cyrtodactylus baluensis* from the family Gekkonidae (16.7%); and finally *Tropidophorus micropus*, *Eutropis rudis* and *Sphenomorphus* sp. from the family Scincidae (50%). Most of these were considered as Least Concern (LC) in the IUCN Red List of Threatened Species data and *Leptobrachella sabahmontana* was the only Endangered (EN) frog species that was documented over the four-night survey. There was one skink species classified as Data Deficient (DD) namely *T. micropus*. Common species of frogs in the list were *F. limnocharis* and *P. leucomystax* and *E. rudis* was the most common reptile encountered during the survey.

Ten (10) species out of the recorded herpetofauna list were endemic to Borneo namely *Ansonia minuta*, *A. spinulifer*, *A. longidigata*, *Meristogenys poecilus*, *Huia cavitympanum*, *Leptolalax gracilis*, *Leptobrachella sabahmontana*, *Philautus hosii*, *Cyrtodactylus baluensis* and *Tropidophorus micropus*.

Significantly, two specimens of *A. minuta* were spotted on leaf near the stream (riparian area) during the night survey at Kipungit River in Melangkap Noriou. The vegetation of the locality comprised of lowland hill forest with the elevation of approximately 600m a.s.l. The snout-vent length of the specimens are 17mm and 23mm, respectively. Both with a weight of 1 gram, the specimens are kept in Sabah Parks Zoological Collection. According to Inger et al., (2017), *A. minuta* has long hind limbs, its snout projecting well beyond the mouth, and tips of the outer fingers are widened. The first finger is distinctly shorter than the second and the toes are fully webbed in males, about three-quarters webbed in females. The upper surfaces of its body and limbs are covered with small, round warts. Adult males have two or three rows of yellowish spines under the chin. This toad has brown with irregular small orange or yellow spots or streaks on the back, its belly is pale with black spots and yellowish dots. The side of the head have dark and light bars, with a whitish area below the eye. This toad is a common lowland stream bufonid that was known only from several localities in Sarawak (Malaysia) and Kalimantan (Indonesia) such as in Kubah National Park, Gading National Park and Mount Penrissen of Sarawak (IUCN SSC Amphibian Specialist Group, 2018). In fact, Inger et al. (2017) stated that *A. minuta* may occur more widely than the current published records which is in line with our finding. This finding in Kadamaian is a new record for Sabah. Meanwhile, the other two *Ansonia* species are dispersing widely within the lowland, hilly and submontane rainforests in Sabah.

Interestingly, *Leptobrachella sabahmontana* which is classified as EN in the IUCN Red List appears to be restricted to Sabah (Northern Borneo) and can be found in the sub-montane to montane forests with the altitude ranges between 750 to 1500m a.s.l (Matsui et al., 2014; IUCN SSC Amphibian Specialist Group, 2019). *L. sabahmontana* was found at two localities within the study area namely at the waterfall near the expedition base camp with an altitude of approximately 600m a.s.l and Kipungit River in Melangkap Noriou. The frogs were spotted on leaf near water sources or streams within the riparian area. The river near the base camp is wide and rocky; and the water current was moderate whereas Kipungit River is small/narrow with slower water current. This species is documented to occur at several localities within Kinabalu Park and Crocker Range Park including Sayap Substation in Kota Belud (Matsui et al., 2014).

Table 1. The amphibians and reptiles recorded from Kadamaian, Kota Belud.

FAMILY	SPECIES	COMMON NAME	LOCALITIES				CONSERVATION STATUS (IUCN)
			Waterfall near base camp	Pinolobu River	Kipungit River, Melangkap Noriou	Meliawa River	
Bufonidae	<i>Ansonia minuta</i> *,**	Dwarf Slender Toad			X		Least concern
	<i>Ansonia spinulifer</i> *	Spiny Slender Toad	X	X	X	X	Least concern
	<i>Ansonia longidigita</i> *	Long-fingered Slender Toad	X		X	X	Least concern
Ranidae	<i>Staurois guttatus</i>	Black-spotted Foot-Flagging Frog	X	X	X	X	Least concern
	<i>Meristogenys poecilus</i> *	Speckle-legged Torrent Frog	X		X	X	Least concern
	<i>Huia cavitympanum</i> *	Hole-in-the-head Frog	X			X	Least concern
Dicroglossidae	<i>Hylarana picturata</i>			X	X		Least concern
	<i>Limnonectes kuhlii</i>	Kuhl's Creek Frog	X	X	X	X	Least concern
	<i>Fejervarya limnocharis</i>			X			Least concern
Megophryidae	<i>Leptotalax gracilis</i> *	Sarawak Slender Litter Frog	X	X	X	X	Least concern
	<i>Leptobrachella sabahmontana</i> *		X				Endangered
Rhacophoridae	<i>Leptobrachium abbotti</i>	Lowland Large-eyed Litter Frog			X	X	Least concern
	<i>Phyllautus hosii</i> *	Hose's Bush Frog	X		X	X	Least concern
	<i>Polypedates leucomystax</i>	Four-lined Tree Frog		X			Least concern
	<i>Polypedates macrotis</i>	Dark-eared Tree Frog		X		X	Least concern
Agamidae	<i>Gonocephalus iogaster</i>				X		
	<i>Branchocela cristatella</i>				X	X	
Gekkonidae	<i>Cyrtodactylus baluensis</i> *				X		
Scincidae	<i>Tropidophorus micropus</i> *		X				Least concern
	<i>Eutropis rudis</i>		X			X	Data deficient
	<i>Sphenomorphus sp.</i>					X	

*Endemic to Borneo, **New record to Sabah, x-Present

Cyrtodactylus baluensis and *Trodiphorus micropus* are both endemic reptiles to Borneo. *C. baluensis* has been reported to occur in several sites near Mount Kinabalu such as at Kadamaian River and near Kiau in Kota Belud (Iskandar & McGuire, 2018). It prefers hilly, submontane and montane rainforest and is suspected to be restricted to high elevations (Sah et al., 2016; Iskandar & McGuire, 2018). Therefore, the occurrence of this lizard within the study site can be expected. *T. micropus* usually inhabits rocky streams and it was found near the waterfall not far from expedition's base camp. However, this species has limited information compared to *C. baluensis* and classified as DD in the IUCN Red List. This skink was documented in Long Bloe Upper Mahakkam River and Murung Raya of Indonesian Borneo and is suspected to be present in protected areas in Borneo (Iskandar et al., 2019).

The remaining endemic herpetofauna that were recorded in the survey, namely *M. poecilus*, *H. cavitympanum*, *L. gracilis* and *P. hosii* are common inhabitants of primary lowland, hilly forests and old growth secondary forests in Borneo. Although these frogs are considered as LC in the IUCN Red List, their populations are declining as a result from habitat loss and forest degradation, yet survive in protected areas in Borneo (IUCN SSC Amphibian Specialist Group, 2018; IUCN SSC Amphibian Specialist Group, 2019; IUCN SSC Amphibian Specialist Group, 2020)

Conclusion

The number of species was low due to the short survey period. However, the team managed to update the list of herpetofauna in Kadamaian area with one Endangered (EN) frog species namely *Leptobrachella sabahmontana* of the family Megophryidae and one new record for Sabah which is *Ansonia minuta* of the family Bufonidae. Nevertheless, this study contributes to Sabah's herpetofauna database and serves as reference for more studies and research in future.

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Appendices

Photos of habitat in selected localities during expedition



Photos of Herpetofauna in Kadamaian, Kota Belud

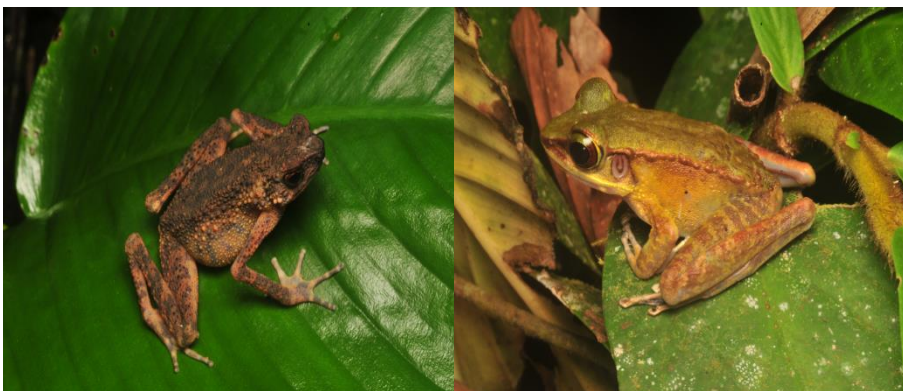




Photo 5. *Huia cavitympanum* was found in 2 localities namely waterfall near base camp and Meliawa river



Photo 6. *Leptolalax gracilis* was found in 3 localities except waterfall near base camp



Photo 7. *Leptobranchella sabahmontana* was found in 2 localities namely waterfall near base camp and Kipungit river, Melangkap Noriou



Photo 8. *Leptobranchium abbotti* was found in 2 localities namely Kipungit river and Meliawa river. Usually spotted on the ground leaf litter.



Photo 9. *Philautus hosii* was recorded in 3 localities except Pinolobu river

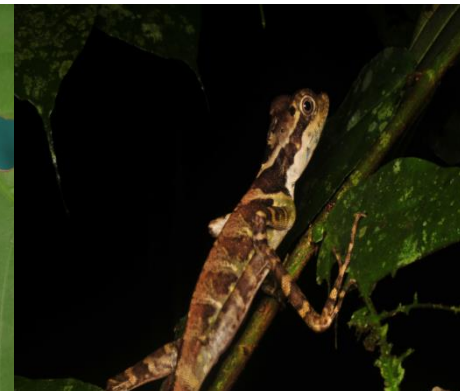


Photo 10. *Gonocephalus liogaster* was found in Kipungit river, Melangkap Noriou



Photo 11. *Branchocela cristatella* was found in 2 localities namely Kipungit river and Meliawa River



Photo 12. *Tropidophorus micropus* was recorded in the waterfall area near base camp



Photo 13. *Cyrtodactylus baluensis* was found in Kipungit river, Melangkap Noriou