

**ANURANS OF PROTECTED AREAS IN SABAH:
TABIN WILDLIFE RESERVE, CROCKER RANGE PARK AND
MALIAU BASIN CONSERVATION AREA**

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ABSTRACT

Tabin Wildlife Reserve (TWR), Crocker Range Park (CRP) and Maliau Basin Conservation Area (MBCA) are three of the more conspicuous protected areas in Sabah: one of the 12 mega biodiversity hotspots of the world. A total of 76 species of anurans (Amphibia: Anura) were recorded in the three protected areas with 26 species in TWR, 63 species in CRP and 24 species in MBCA. Unless otherwise stated, the data presented are from scientific expeditions organized by the Institute for Tropical Biology and Conservation (ITBC), Universiti Malaysia Sabah (UMS). The data dated back to between 1988 – 2002. The anuran species are dwellers of primary as well as secondary lowlands to montane zones (> 2,000 m above sea level). Forty-eight species are endemic to Borneo representing 48.9% of the total number of species endemic to Borneo, while six of the species are endemic to Sabah representing 66.7% of the total number of species endemic to Sabah. Inevitably and progressively, the anuran inventories and total anuran species of the three protected areas are to be enhanced. The data are useful to improve the management plans for all three protected areas towards more effective and efficient conservation of the natural environment.

Keywords: Anurans, Sabah, protected areas, diversity, endemism, conservation

INTRODUCTION

Tabin Wildlife Reserve (TWR), Crocker Range Park (CRP) and Maliau Basin Conservation Area (MBCA) are three of the more conspicuous protected areas in Sabah: one of the 12 mega biodiversity hotspots of the world. The three areas agglomerated represents 37.9% of the protected areas in Sabah, all for distinctive purposes, in different sizes as well as under various legal frameworks and management approaches. TWR, CRP and MBCA encase a spectrum of forest types from lowland to montane.

TWR was gazetted in 1984 under the Forestry Enactment, 1968, and is being managed by Sabah Forestry Department and Sabah Wildlife Department (empowered by the Wildlife Conservation Enactment, 1997). The wildlife reserve, which encompasses an area of 1,205.21 km² in Kinabatangan (Sandakan Division) and Lahad Datu (Tawau Division) Districts, aims to conserve and protect the last remaining lowland Dipterocarp forest with high biodiversity and key species such as Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), Orangutan (*Pongo pygmaeus*), Asian Elephant (*Elephas maximus*), Tembadau (*Bos javanicus*), Clouded Leopard (*Neofelis nebulosa*) and Sun Bear (*Helarctos malayanus*). In the same year, CRP was gazetted too but under the Parks Enactment, 1984, and is being managed by Sabah Parks. CRP spans eight districts: Tuaran, Ranau, Penampang and Papar in the West Coast Division as well as Tambunan, Keningau, Beaufort and Tenom in the Interior Division, with a coverage of 1,399.19 km² making it the largest protected area in Sabah yet. The park aims to preserve and protect the watersheds of 12 main rivers in the West Coast and Interior Divisions, and to protect the habitats of Rafflesia. On the other hand, MBCA enjoys double protections as after its gazettelement in 1981, it was upgraded to a Class I Forest Reserve under the Forestry Enactment, 1968, in 1997 and as a Cultural Heritage Site under the Cultural Heritage (Conservation) Enactment, 1997, in 1999. The management of MBCA is entrusted to an inter-agencies management committee. The 588.4 km² and absolutely uninhabited

conservation area that lies in Kinabatangan (Sandakan Division) and Pensiangan (Interior Division) Districts upholds the purpose to protect the only pristine rainforest and heath forest with remarkable natural features (Regis, 2000).

TWR houses a mixture of primary (mainly in the core area) and secondary lowland forests while CRP and MBCA are clothed with primary and secondary lowland to montane forests. The elevations vary between 200 m to higher than 2,000 m above sea level. These forest types and elevations proffer a wide variety of habitats and microhabitats to hordes of different fauna, including anurans (Amphibia: Anura).

Adhering to the axioms of anurans as good environmental indicators and that there is pressing demand for biodiversity researches (Stuebing, 1998; Inger *et al.*, 2000) to substantiate sustainable development, as well as of the necessity to comprehend the global dwindling of anuran populations (Blaustein and Wake, 1990; Anderson, 1998; Leong, 2002; Fagan, 2005), fragmentary anuran inventories need to be compiled for efficient reference and easy comparison. This paper consolidates anuran inventories of TWR, CRP and MBCA from collections done as early as in 1988 to 2002. The collections were undertaken by herpetologists and staff from Universiti Kebangsaan Malaysia (Sabah Campus), Field Museum of Natural History, Department of Zoology, Chicago, Sabah Parks, Sabah Wildlife Department, Sabah Museum, Universiti Malaysia Sarawak and Universiti Malaysia Sabah (Institute for Tropical Biology and Conservation as well as School of Science and Technology).

MATERIALS AND METHODS

Collections were carried out at night with two to four persons sampled for three to four hours from 2000 h onwards for each collection. Opportunistic examination was conducted on vegetations, puddles, temporary ponds and pools, seepages, rivulets, streams, fallen trees, tree

stumps, rotten logs, leaf litter as well as rocks in streams and on muddy paths. Opportunistic examination is a standard herpetological sampling method to yield holistic collections of arboreal, terrestrial and riparian anurans (e.g., Andreone *et al.*, 1998). Anurans were also located by their calls and eye shines due to reflection from torchlights and headlamps.

Anurans were captured by hand and each put into a separate, clean and transparent plastic bag to be kept overnight. On the following day, the anurans were identified to species based on Inger and Stuebing (1997), recorded and photographed. The anurans were killed with Chlorobutanol solution so that they remained soft to ease positioning. Specimens were labelled with BORNEENSIS specimen numbers. Specimens properly positioned in flat Tupperware® containers layered with tissue paper soaked with 10% formalin were sparingly sprayed with 10% formalin with a syringe. Fleshy specimens were injected with the same chemical into the abdominal cavities, necks and limbs. Then, the specimens were left overnight in covered flat Tupperware® containers. Subsequently, hardened specimens were fixed in 10% formalin until returning to the repository: BORNEENSIS, Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah. Then, the specimens were rinsed and put into 70% ethanol for long-term preservation.

For this paper, data for TWR were compiled from Christovol *et al.* (1999) and Kueh and Maryati (2003). Data from Christovol *et al.* (1999) were from collections undertaken for three nights in March 1998 at the core area of TWR during the extremely dry season towards the end of the *El Nino* period, as well as five nights in September 1998 at the northern part of TWR during the wet season. Data from Kueh and Maryati (2003) were yielded from seven nights of collection (16 – 22 October 2000) at the limestone area of north-eastern TWR during the wet season.

For CRP, data were compiled from Inger *et al.* (2000), Ramlah *et al.* (2001) and Kueh *et al.* (2004). Data from Inger *et al.* (2000) were from Sungai Purulon, Sungai Kilampon (15

June – 16 July 1989 and 5 – 25 September 1990), Sungai Malutut (22 November – 9 December 1988) and near the Sunsuron Pass on the Kota Kinabalu – Tambunan road (9 – 24 January 1989, 6 – 23 September 1989 and 30 August – 12 September 1992). On the other hand, data from Ramlah *et al.* (2001) included data from Sunsuron collected in 1989, and the vicinity of CRP Headquarter, near the road to Keningau and Mahua waterfall sampled in October 1999 for 14 nights. Kueh *et al.* (2004) grouped data collected at Sungai Kimanis, near the Keningau – Kimanis road, Trail 5, Trail 7 and Trail 11 on 26 August – 12 September 2002.

For MBCA, data were compiled from Abdul-Hamid and Wong (1998) and unpublished data from the vicinity of Agathis Camp. Data from Abdul-Hamid and Wong (1998) were collected on 14 – 22 May 1996 while from the vicinity of Agathis Camp, southern edge of MBCA, on 12 – 14 May 2001.

Other than the data from Inger *et al.* (2000) and Ramlah *et al.* (2001), the rest were from scientific expeditions organized by the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah.

RESULTS AND DISCUSSION

Collectively, a whopping total of 76 species of anurans were recorded in the three protected areas with 26 species in TWR, 63 species in CRP and 24 species in MBCA as presented in Table 1. The disparity among the number of species recorded in each protected area was highly attributed to sampling effort and duration. More and longer collections were done at CRP as compared to TWR and MBCA. The species recorded were from five out of six families in Borneo, namely Bufonidae (12 species), Megophryidae (9 species), Microhylidae (9 species), Ranidae (27 species) and Rhacophoridae (19 species).

The family Ranidae had the largest collection which represented approximately 36% of the inventory. As Ranidae is the biggest and widest distributed anuran family in Borneo, it is absolutely logical that ranids are more likely to be sampled than any other anurans. Besides, it could be an artefact of the habitats and microhabitats sampled during the collections. Streams, rivulets, seepages and water bodies were combed more than vegetations and leaf litters. As ranids have predilection for habitats and microhabitats closely related to water, hence, the collections sampled more species from this family.

Most of the species recorded are dwellers of primary or at least old secondary forests, with a handful of primary forest specialists. The primary forest specialists are exemplified by bufonids: *Ansonia spinulifer*, *Pedostibes hosii* and *P. rugosus*, microhylids: *Kalophrynus baluensis*, *K. pleurostigma*, *Metaphrynella sundana* and *Microhyla borneensis*, ranids: *Huia cavitympanum*, *Limnonectes palavanensis*, *Staurois latopalmatus*, *S. natator* and *S. tuberilinguis* as well as rhacophorids: *Rhacophorus angulirostris*, *R. bimaculatus*, *R. dulitensis*, *R. everetti* and *R. gauni*. These species depend heavily on pristine ecosystems proffered by primary forests to lay eggs and survive. The utmost importance of primary forests is further reiterated by the fact that the natural history of certain species in terms of life history (of *Rhacophorus dulitensis*), acoustics (of *Pedostibes rugosus* and *Rhacophorus bimaculatus*) and tadpole descriptions (of *Kalophrynus baluensis* and *Rhacophorus everetti*) are very much still unknown (Inger and Stuebing, 1997; Malkmus *et al.*, 2002).

The anuran inventory of TWR, CRP and MBCA enlisted species that live in slightly disturbed and man-made habitats too. Species which can also inhabit the former environment are such as *Limnonectes ingeri*, *L. leporinus*, *L. malesianus*, *Rana chalconota*, *R. hosii*, *R. picturata*, *R. signata* (family Ranidae), *Polypedates macrotis* and *P. otilophus* (family Rhacophoridae). Five species recorded are associated with man-made habitats and even considered to depend on humans to provide the preferred environment to survive. The species

are *Fejervarya limnocharis*, *Limnonectes cancrivorus*, *Rana erythraea*, *R. nicobariensis* and *Polypedates leucomystax*.

The anuran species recorded also represent dwellers of varied altitudes. The sampling sites were conscientiously chosen to depict different forest elevations: lowlands (5 ~ 800 m above sea level), hilly and lower montane zone (801 ~ 2,000 m above sea level) and montane zone (> 2,000 m above sea level). Most of the ranids, bufonids and microhylids can be found in lowlands. These with the megophryids transcend into hilly and lower montane forests. The bufonids and rhacophorids are readily available in lower montane as well as montane forests.

Forty-eight species recorded are endemic to Borneo with six which are endemic to Sabah as well. The endemic species respectively represent 48.9% of the total number of species endemic to Borneo and 66.7% of the total number of species endemic to Sabah. Indeed, high endemism at TWR, CRP and MBCA is parallel to the finding of a research on the application of biogeographical data of anurans through WORLDMAP Programme to prioritize conservation areas in Borneo (Kueh, 2003).

CONCLUSION

Indeed, TWR, CRP and MBCA are three protected areas with impressive anuran diversity that is manifested into high species richness and endemism. However, more species are waiting to be added to the inventory as nearly 47% of all the anuran species in Borneo has yet to be recorded in TWR, CRP and MBCA. Compilation of more fragmentary inventories should also be undertaken in order to produce more comprehensive anuran inventories and total anuran species of the three protected areas. In return, data from the enhanced anuran inventories and total anuran species are useful to improve the management plans for all three protected areas towards more effective and efficient conservation of the natural environment.

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Table 1. Anurans recorded in Tabin Wildlife Reserve (TWR), Crocker Range Park (CRP) and Maliau Basin Conservation Area (MBCA).

	TWR	CRP	MBCA
<u>(I) Family BUFONIDAE</u>			
(1.) <i>Ansonia hanitschi</i> Inger *		3, 4, 5	6
(2.) <i>Ansonia leptopus</i> (Günther) *	1	4	7
(3.) <i>Ansonia longidigita</i> Inger *		3, 4, 5	6
(4.) <i>Ansonia platysoma</i> Inger *		3, 5	
(5.) <i>Ansonia spinulifer</i> (Mocquard) *		5	
(6.) <i>Bufo asper</i> Gravenhorst		3	
(7.) <i>Bufo divergens</i> Peters *			6, 7
(8.) <i>Bufo juxtasper</i> Inger *	1	3, 4, 5	6, 7
(9.) <i>Leptophryne borbonica</i> (Tschudi)		5	
(10.) <i>Pedostibes hosii</i> (Boulenger) *	1, 2		
(11.) <i>Pedostibes maculatus</i> (Mocquard) *		5	
(12.) <i>Pedostibes rugosus</i> Inger *		3	
<u>(II) Family MEGOPHRYIDAE</u>			
(13.) <i>Leptobranchella baluensis</i> Smith *		3, 5	
(14.) <i>Leptobranchella parva</i> Dring *		3, 5	
(15.) <i>Leptobranchium abbotti</i> (Cochran) *		3	6
(16.) <i>Leptobranchium montanum</i> Fischer *		3, 4, 5	6
(17.) <i>Leptobranchium</i> sp.	1		
(18.) <i>Leptolalax dringi</i> Dubois *		3, 5	
(19.) <i>Leptolalax gracilis</i> (Günther)		4	
(20.) <i>Leptolalax pictus</i> Malkmus **		3, 4	
(21.) <i>Megophrys nasuta</i> (Schlegel)	1	3, 4, 5	6
<u>(III) Family MICROHYLIDAE</u>			
(22.) <i>Calluella</i> sp. *			6
(23.) <i>Chaperina fusca</i> Mocquard	1, 2	3, 5	
(24.) <i>Kalophrynus baluensis</i> Kiew **		3	
(25.) <i>Kalophrynus heterochirus</i> Boulenger *		3, 5	7
(26.) <i>Kalophrynus pleurostigma</i> Tschudi		3, 4, 5	
(27.) <i>Kalophrynus subterrestris</i> Inger *		3	
(28.) <i>Metaphrynella sundana</i> (Peters)	2	5	6
(29.) <i>Microhyla borneensis</i> Parker *		5	
(30.) <i>Microhyla berdmorei</i> (Blyth)			6
<u>(IV) Family RANIDAE</u>			
(31.) <i>Huia cavitympanum</i> (Boulenger) *		3	
(32.) <i>Ingerana baluensis</i> (Boulenger) *		3, 5	
(33.) <i>Fejervarya limnocharis</i> Boie	2	3, 4, 5	
(34.) <i>Limnonectes cancrivorus</i> (Gravenhorst)	1		
(35.) <i>Limnonectes finchi</i> (Inger) **	1	3, 4, 5	
(36.) <i>Limnonectes ingeri</i> (Kiew) *	1, 2	5	
(37.) <i>Limnonectes kuhlii</i> (Tschudi)	2	3, 4, 5	6, 7
(38.) <i>Limnonectes leporinus</i> (Andersson) *	1	3, 5	6, 7
(39.) <i>Limnonectes malesianus</i> (Kiew)	2		
(40.) <i>Limnonectes palavanensis</i> (Boulenger)		3, 5	

(41.)	<i>Meristogenys amoropalamus</i> (Matsui) *		3	
(42.)	<i>Meristogenys kinabaluensis</i> (Inger) *		3, 4, 5	
(43.)	<i>Meristogenys orphnocnemis</i> (Matsui) *		3, 5	
(44.)	<i>Meristogenys poecilus</i> (Inger & Gritis) *		4	
(45.)	<i>Meristogenys whiteheadi</i> (Boulenger) *		3	
(46.)	<i>Occidozyga baluensis</i> (Boulenger) *	1, 2	3, 4, 5	
(47.)	<i>Occidozyga laevis</i> (Günther)	1, 2		
(48.)	<i>Rana chalconota</i> (Schlegel)	1, 2	3, 5	
(49.)	<i>Rana erythraea</i> (Schlegel)		5	
(50.)	<i>Rana hosii</i> Boulenger	1	3	6
(51.)	<i>Rana luctuosa</i> (Peters)		5	
(52.)	<i>Rana nicobariensis</i> (Stoliczka)	1, 2		
(53.)	<i>Rana picturata</i> Boulenger *	1	3	7
(54.)	<i>Rana signata</i> (Günther)	1	3	6
(55.)	<i>Staurois latopalmatus</i> (Boulenger) *		3, 5	
(56.)	<i>Staurois natator</i> (Günther) *	1	3, 4, 5	6
(57.)	<i>Staurois tuberilinguis</i> Boulenger *		3, 4, 5	6, 7
(V)	<u>Family RHACOPHORIDAE</u>			
(58.)	<i>Nyctixalus pictus</i> (Peters)		3, 5	
(59.)	<i>Philautus aurantium</i> Inger **		5	
(60.)	<i>Philautus bunitus</i> Inger, Stuebing & Tan **		3, 5	
(61.)	<i>Philautus hosii</i> (Boulenger) *		5	
(62.)	<i>Philautus longicrus</i> (Boulenger) *		3	
(63.)	<i>Philautus mjöbergi</i> Smith *		5	
(64.)	<i>Philautus petersi</i> (Boulenger) *		3, 5	
(65.)	<i>Polypedates colletti</i> (Boulenger)			6
(66.)	<i>Polypedates leucomystax</i> (Gravenhorst)		3, 5	
(67.)	<i>Polypedates macrotis</i> (Boulenger)		3, 4, 5	6
(68.)	<i>Polypedates otlophus</i> (Boulenger) *	1, 2	3, 5	
(69.)	<i>Rhacophorus angulirostris</i> Ahl **		3, 5	
(70.)	<i>Rhacophorus appendiculatus</i> (Günther)	1		6
(71.)	<i>Rhacophorus baluensis</i> Inger *		3	
(72.)	<i>Rhacophorus bimaculatus</i> (Peters)			6
(73.)	<i>Rhacophorus dulitensis</i> Boulenger *	2		
(74.)	<i>Rhacophorus everetti</i> Boulenger *		3, 5	
(75.)	<i>Rhacophorus gauni</i> (Inger) *		3, 5	6
(76.)	<i>Rhacophorus pardalis</i> Günther	1, 2	5	

Sources : 1 = Christovol *et al.*, 1999
2 = Kueh and Maryati, 2003
3 = Inger *et al.*, 2000
4 = Ramlah *et al.*, 2001
5 = Kueh *et al.*, 2004
6 = Abdul-Hamid and Wong, 1998

7 = Collection from the vicinity of Agathis Camp in 2001

Keys : * = Endemic to Borneo

** = Endemic to Sabah