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First Record of the Tree-frog Genus *Chiromantis* from Borneo with the Description of a New Species (Amphibia: Rhacophoridae)

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We record a tree frog of the genus *Chiromantis* for the first time from outside the Southeast Asian continent and describe it as a new species, *Chiromantis inexpectatus*. The new species from the Malaysian state of Sabah, Borneo, is a small-sized *Chiromantis* (male snout-vent length ca. 22 mm), and is distinguished from all other members of the genus by the combination of the following morphological characteristics: dark stripes absent, but dark spots present on dorsum; a dark-brown lateral band present from snout tip to half of body, bordered ventrally by white stripe; third and fourth fingers less than half webbed; third finger disk wider than tympanum diameter; and inner metatarsal tubercle present. Significance of findings of this species from Borneo Island, as well as phylogeny and breeding habit of the genus *Chiromantis*, are briefly discussed.

Key words: *Chiromantis inexpectatus*, mitochondrial phylogeny, Southeast Asia, taxonomy, zoogeography

INTRODUCTION

The Old-World tree-frog genus *Chiromantis* Peters, 1854 had long been confined to several African tree frogs (Liem, 1970; Frost, 1985), but based on results of recent molecular studies on rhacophorids (Frost et al., 2006), the genus was enlarged to contain frogs formerly known as *Chirixalus* Boulenger, 1893 occurring from southern China through Thailand to northeastern India (e.g., Bourret, 1942; Taylor, 1962). Recently, two additional new species have been described from the Asian continent (Grismer et al., 2007; Chan et al., 2011).

Outside the continental region of Southeast Asia, no formal report of occurrence of the genus has been given, although their presence in Sumatra and Java is likely (Amir Hamidy, pers. comm.). However, our field survey in Sabah, Malaysian Borneo, revealed presence of a small rhacophorid species morphologically similar to the genus *Chiromantis* there. The species formed a clade on mtDNA trees with some members of the genus, and also differed from all the known congeneric members morphologically. Hence we describe it as a new species of *Chiromantis*, which is the first formal record of the genus outside the Southeast Asian continent.

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MATERIALS AND METHODS

We obtained DNA sequence data from tissues preserved in 99% ethanol for a specimen of rhacophorid species from Sabah (BORNEENSIS [BORNEENSIS collection, Institute for Tropical Biology and Conservation, University Malaysia Sabah] 22421; GenBank accession number AB813160), *Chiromantis doriae* (Boulenger, 1893) from Phu Luang, Thailand (KUHE [Kyoto University, Graduate School of Human and Environmental Studies] 19301; AB813159), *C. nongkhorensis* (Cochran, 1927) from Song Khla Buri, Thailand (KUHE 19498; AB813158), *C. xerampelina* Peters, 1854 from pet trade (KUHE 46345; AB813157), *C. vittatus* (Boulenger, 1887) from Song Khla Buri, Thailand (KUHE 19441; AB813162), *C. hansenae* (Cochran, 1927) from Nam Tok Hongkaew, Thailand (KUHE 34136; AB813161), *Rhacophorus gauni* (Inger, 1966) from Sarawak (KUHE 53511; AB847124), *R. dulitensis* Boulenger, 1892 from Sabah (BORN 09097; AB847123), *Feihyla kajau* (Dring, 1984) from Sarawak (KUHE 53591; AB847122), *Theloderma leprosum* Tschudi, 1838 from Malay Peninsula (KUHE 52581; AB847128), *Kurixalus appendiculatus* (Günther, 1859) from Sarawak (KUHE 53614; AB847125), *Philautus davidlabangi* Matsui, 2009 from Sarawak (KUHE 19594; AB847127), and *Ph. macroscelis* (Boulenger, 1893) from Sabah (BORN 08499; AB847126). Methods for DNA extraction, and amplification and sequencing of the mtDNA fragments are the same as those reported by Kuraishi et al. (2013). We deposited the resultant sequences (1987 base pairs [bp] of partial sequences of mitochondrial 12S and 16S rRNA genes and the intervening tRNA gene) in GenBank (Accession numbers AB813157–813162, 847122–847128, as shown above). In addition to our own new sequence data, we used GenBank data of *C. rufescens* (Günther, 1869) (AF 458126), *Polypedates leucomystax* (Gravenhorst, 1829) (AB728138), *R. borneensis* Matsui et al., 2013 (AB781693), *Nyctixalus pictus* (Peters, 1871) (DQ283133), *Buergeria buergeri* (Temminck and

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Schlegel, 1838) (AB127977), and a mantellid, *Aglyptodactylus madagascariensis* (Duméril, 1853) (DQ283056). For tree construction and calculation of genetic distances (uncorrected p-distance), we followed Kuraishi et al. (2013).

Specimens examined are stored in the BORNEENSIS collection. We took the following 25 body measurements to the nearest 0.05 mm with a dial caliper under a binocular microscope, following Matsui (1984, 1994): (1) snout–vent length (SVL); (2) head length (HL) from tip of snout to hind border of angle of jaw, not measured parallel with the median line; (3) snout–nostril length (S-NL); (4) nostril–eyelid length (N-EL); (5) snout length (SL); (6) eye length (EL); (7) eye diameter (ED), diameter of the exposed portion of the eyeball; (8) tympanum–eye length (T-EL); (9) tympanum diameter (TD); (10) head width (HW); (11) internarial distance (IND); (12) interorbital distance (IOD); (13) upper eyelid width (UEW); (14) forelimb length (FLL); (15) lower arm and hand length (LAL); (16) first finger length (1FL), measured from distal edge of inner palmar tubercle; (17) inner palmar tubercle length (IPTL); (18) hindlimb length (HLL); (19) thigh length (THIGH); (20) tibia length (TL); (21) foot length (FL); (22) first toe length (1TOEL); (23) inner metatarsal tubercle length (IMTL); (24) third finger disk diameter (3FDW); and (25) fourth toe disk diameter (4TDW). We followed the system of description of toe-webbing states used by Savage (1975).

SYSTEMATICS

The topology of the maximum-likelihood (ML) and Bayesian trees was nearly identical, and only the former is shown in Fig. 1. Support for the monophyly of the rhacophorid sp. from Sabah and six species of *Chiromantis* was sufficient in the Bayesian tree (Bayesian posterior probability [BPP] = 0.98), but was moderate in the ML tree (bootstrap support [BS] = 67%). Two groups were recognized in the clade, and the first group formed a fully-supported clade (BS = 100%, BPP = 1.00) and contained four *Chiromantis* species, in which *C. doriae* and *C. nongkhorensis*, and *C. xerampelina* and *C. rufescens*, respectively, showed sister relationships. The second group contained a fully-supported clade of *C. vittatus* and *C. hansenae* (BS = 100%, BPP = 1.00) and the rhacophorid sp. from Sabah, and the monophyly of the group was moderately supported (BS = 71%, BPP = 0.97). Although the relationships were not highly supported, these results indicate placement of the rhacophorid sp. from Sabah in the genus *Chiromantis*.

Chiromantis sp. from Sabah differed genetically from the six species of *Chiromantis* by large genetic distances (16.1–18.6%: Table 1), and the species also substantially differed from species of the other genera (14.7% from *F. kajau* to 20.7% from *P. leucomystax*). The distances between the six species of *Chiromantis* ranged from 5.7–20.9%. Further-

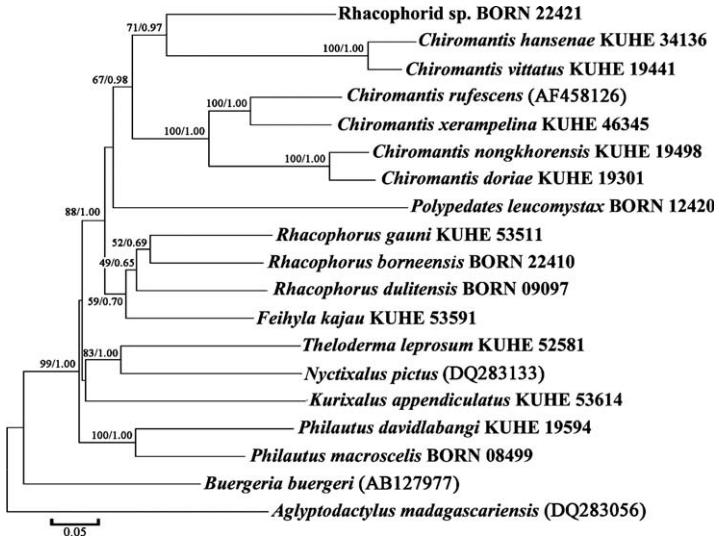


Fig. 1. Maximum-likelihood (ML) tree from a 1987 bp sequence of mitochondrial 12S and 16S rRNA genes and the intervening tRNA gene for the rhacophorid from Sabah, members of the *Chiromantis*, Bornean rhacophorines, and a buergerine and a mantellid species. Numbers above or below branches represent bootstrap supports for ML inferences and Bayesian posterior probabilities.

Table 1. Uncorrected p-distances (in %) for fragment of 16S rRNA among 18 rhacophorid and a mantellid taxa compared.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Rhacophorid sp. from Sabah BORNEENSIS 22421																		
2 *Chiromantis hansenae* KUHE 34136	18.2																	
3 *Chiromantis vittatus* KUHE 19441	17.9	5.7																
4 *Chiromantis rufescens* (AF458126)	17.8	19.8	20.0															
5 *Chiromantis xerampelina* KUHE 46345	16.1	18.9	18.8	10.4														
6 *Chiromantis nongkhorensis* KUHE 19498	18.6	20.4	20.6	14.0	14.2													
7 *Chiromantis doriae* KUHE 19301	18.5	20.6	20.9	14.6	14.2	6.5												
8 *Polypedates leucomystax* BORNEENSIS 12420	20.7	22.5	22.1	20.3	21.1	20.9	21.6											
9 *Rhacophorus gauni* KUHE 53511	17.1	18.7	19.0	16.4	16.8	17.8	17.9	18.9										
10 *Rhacophorus borneensis* BORNEENSIS 22410	17.2	18.8	19.0	17.8	17.4	18.5	18.1	19.0	12.2									
11 *Rhacophorus dulitensis* BORNEENSIS 09087	16.4	18.6	18.6	15.8	16.3	16.5	16.7	18.4	13.2	12.8								
12 *Feihyla kajau* KUHE 53591	14.7	17.5	17.7	15.2	15.5	16.2	16.6	18.2	13.6	13.0	13.1							
13 *Theloderma leprosum* KUHE 52581	18.2	21.7	20.8	19.0	19.5	19.6	19.3	21.3	16.3	15.9	16.9	15.1						
14 *Nyctixalus pictus* (DQ283133)	19.0	20.0	19.4	20.0	20.4	20.2	20.5	20.5	17.5	16.8	16.2	16.2	17.5					
15 *Kurixalus appendiculatus* KUHE 53614	19.2	19.4	19.4	19.4	18.5	18.9	19.4	21.1	17.5	16.4	17.5	17.4	18.5	18.8				
16 *Philautus davidlabangi* KUHE 19594	18.8	19.5	19.3	18.4	17.9	19.1	19.6	21.4	16.7	16.6	16.9	16.7	16.9	19.4	17.9			
17 *Philautus macroscelis* BORNEENSIS 08499	18.0	20.7	20.2	18.7	18.4	18.5	18.7	21.4	16.5	16.9	16.8	15.6	17.5	19.6	18.0	14.1		
18 *Buergeria buergeri* (AB127977)	17.1	19.5	19.9	17.9	17.2	19.5	19.0	20.0	15.9	16.1	17.1	15.8	17.8	19.5	18.8	17.7	17.2	
19 *Aglyptodactylus madagascariensis* (DQ283056)	20.8	22.1	21.9	20.5	19.7	21.1	21.0	22.0	19.1	19.0	18.4	18.4	21.3	20.9	21.6	20.4	20.0	18.7

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more, *Chiromantis* sp. from Sabah is separated morphologically from all nominal species of *Chiromantis* in congruent with genetic separation. Thus, we conclude the rhacophorid specimens from Sabah, Borneo as a distinct species in the genus *Chiromantis* and describe it as follows:

***Chiromantis inexpectatus* sp. nov.**
Bornean opposite-fingered tree frog
(Figs. 2–5)

Diagnosis

Chiromantis inexpectatus is distinguishable from its congeners by the combination of the following characters: (1) size small, SVL 22.2–22.4 mm in males, (2) dark stripes absent, but dark spots present on dorsum, (3) a dark-brown lateral band present from snout tip to half of body, bordered below by white stripe, (4) third and fourth fingers less than half webbed (III 2–2.5 IV), (5) third finger disk wider but toe disks narrower than tympanum diameter, (6) inner metatarsal tubercle present.

Etymology

The specific name is a Latin adjective, referring to the fact that the occurrence of the genus on the island of Borneo, where the new species was found, was unexpected.

Holotype

BORNEENSIS 22421, adult male, collected by Tomohiko Shimada on 9 March 2005 from Camel Trophy field station (4°54′ N, 116°53′ E; ca. 1050 m a.s.l.) of the Maliau Basin Conservation Area, Sandakan Division, Sabah, East Malaysia.

Paratypes

BORNEENSIS 22419, metamorphosing young, and BORNEENSIS 22420, adult male, same collection details as for holotype.

Description of holotype

Adult male; SVL 22.2 mm; head longer (HL 38.7% SVL) than wide (HW 36.9% SVL), wider than body, relatively flat; snout truncated in lateral view, length (SL 14.9% SVL) subequal to eye length (EL 14.4% SVL), sloping anteroventrally, projecting beyond mouth; canthus rostralis rounded; loreal region vertical and concave; nostril nearer to tip of snout (S-NL 8.1% SVL) than to eye (N-EL 9.0% SVL); internarial distance (IND 12.4% SVL) less than interorbital distance (IOD 14.9% SVL), which in turn nearly twice as wide as upper eyelid (UEW 7.9% SVL); eye large, protuberant; tympanum distinct, subcircular, diameter (TD 5.4% SVL) three-eighths of eye length and separated from eye by one-eighth of tympanum diameter (T-EL 0.7% SVL); vomerine teeth absent; choana oval; tongue notched posteriorly; single median vocal sac; vocal slits on floor of mouth well anterior to jaw commissure on both sides.

Forelimb long (FLL 67.1% SVL); hand and forearm long (LAL 56.3% SVL) and relatively robust; finger length formula: I < II < IV < III; expanded disks each with a circummarginal groove and a transverse ventral groove; disks on third and fourth fingers (3FDW 6.1% SVL) only slightly wider than those on second (2FDW 6.0% SVL) and first (1FDW 5.9% SVL), all wider than tympanum; no webbing between first and second fingers; second and third fingers, and third and fourth fingers less than half webbed (II 3–3 III 2–2.5 IV); inner two fingers widely separated from outer two fingers (opposable); subarticular tubercle between penultimate and adjoining proximal phalange on third and fourth fingers indistinct; inner palmar tubercle flat (IPTL 5.4% SVL), outer one absent; nuptial pad absent.

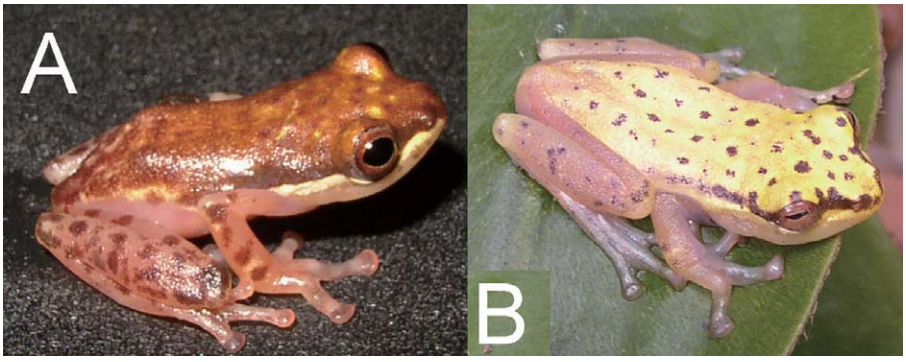


Fig. 2. **(A)** Male holotype (BORNEENSIS 22421) and **(B)** male paratype (BORNEENSIS 22420) of *Chiromantis inexpectatus* in life, showing different color phase.

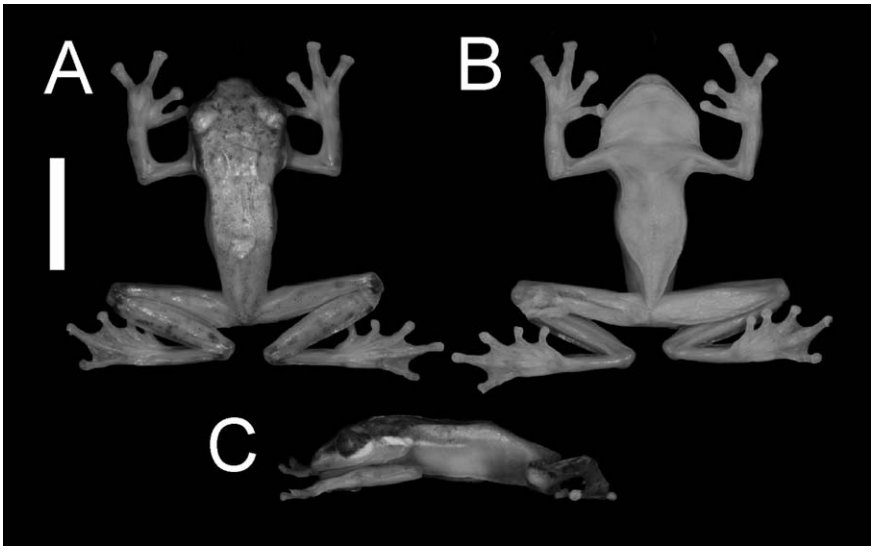


Fig. 3. **(A)** Dorsal, **(B)** ventral, and **(C)** lateral views of male holotype (BORNEENSIS 22421) of *Chiromantis inexpectatus* after preservation. Scale bar = 10 mm.

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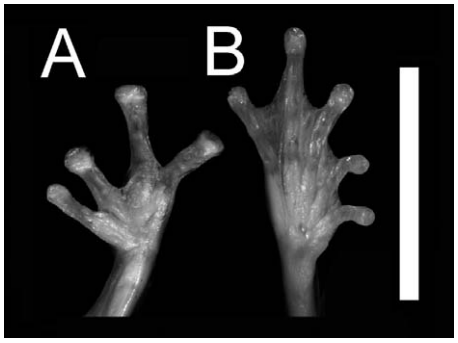


Fig. 4. Ventral views of **(A)** left hand and **(B)** right foot of male holotype (BORNEENSIS 22421) of *Chiromantis inexpectatus* after preservation. Scale bar = 10 mm.

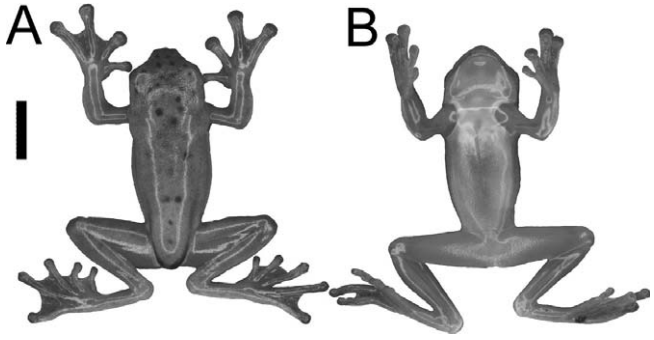


Fig. 5. **(A)** Dorsal and **(B)** ventral views of juvenile paratype (BORNEENSIS 22419) of *Chiromantis inexpectatus* in anesthesized condition. Scale bar = 5 mm.

Hindlimb relatively short (HLL 159.9% SVL); tibiotarsal articulation extends to anterior corner of eye when fully stretched leg adpressed to body; heels touching each other when thigh (THIGH 54.7% SVL) and tibia (TL 54.5% SVL) placed at right angle to body; foot (FL 41.9% SVL) much shorter than tibia; toe length formula I < II < III < V < IV; toes bearing expanded disks each with a circummarginal groove and a transverse ventral groove, width of fourth toe disk (4TDW 4.7% SVL) much narrower than those of finger disks; webbing formula I 2–2 II $1^1/_2$–2 III $1^1/_2$–2 IV$1^1/_2$–$1^1/_2$ V; subarticular tubercles oval, poorly developed; inner metatarsal tubercle small (IMTL 3.6% SVL) and flat, about one-third length of first toe (1TOEL 11.5% SVL); no outer metatarsal tubercle.

Dorsal surface nearly smooth, sparsely scattered with minute, blunt asperities between shoulder and sacral regions; supratympanic fold weak, continued as glandular fold to shoulder; skin of lower jaw posterolaterally forming a short fold at anterior base of upper arm; ventral surface composed of flat granules; skin of ventral surface of foot smooth, with longitudinal folds.

Color

The color changes in life: when captured, the dorsal ground color was whitish-yellow on body and pinkish on limbs, but later changed to light brown (Fig. 2). Dorsum scattered with vaguely defined small dark-brown spots; a dark-brown lateral band extending from tip of snout, through lower eyelid, upper half of tympanum, to fade one-half way down body, bordered ventrally by a narrower white stripe extending from snout tip below canthus, through lower eyelid and tympanum; venter immaculate creamy white, semi-transparent.

In alcohol, all dorsal and ventral surfaces faded to beige, but dark-brown and white stripes remained.

Table 2. Measurements (in mm) of types of *Chiromantis inexpectatus*. See text for abbreviations.

No.	Sex	SVL	HL	S-NL	N-EL	SL	EL	ED
BORNEENSIS 22421	M	22.2	8.6	1.8	2.0	3.3	3.2	2.8
BORNEENSIS 22420	M	22.4	8.8	1.6	1.75	3.4	3.5	2.9
BORNEENSIS 22419	MetaY	17.9	6.4	1.1	1.45	2.55	2.85	2.1
		T-EL	TD	HW	IND	IOD	UEW	FLL
BORNEENSIS 22421	M	0.15	1.2	8.2	2.75	3.3	1.75	14.9
BORNEENSIS 22420	M	0.2	1.0	8.25	2.9	3.4	1.7	15.3
BORNEENSIS 22419	MetaY	–	–	5.8	1.8	2.5	1.45	12.15
		LAL	1FL	IPTL	HLL	Thigh	TL	FL
BORNEENSIS 22421	M	12.5	2.75	1.2	35.5	12.15	12.1	9.3
BORNEENSIS 22420	M	12.5	2.55	1.45	36.5	11.7	11.3	9.2
BORNEENSIS 22419	MetaY	9.9	1.65	1.15	26.5	8.95	9.0	7.5
		1TOEL	IMTL	3FDW	4TDW			
BORNEENSIS 22421	M	2.55	0.8	1.35	1.05			
BORNEENSIS 22420	M	2.4	1.1	1.35	1.15			
BORNEENSIS 22419	MetaY	2.15	0.73	1.05	0.9			

Variation

Morphometric variation is shown in Table 2. The male paratype (BORNEENSIS 22420) is generally similar with the holotype in general morphology and coloration, but has more isolated, clearer dark spots. Another paratype (BORNEENSIS 22419) is a metamorphosing juvenile with a tail stub of 0.1 mm and lacks a visible tympanum. Dark-brown lateral band is indistinct and ventral white stripe is not recognizable.

Range

Known from the type locality, Camel Trophy of the Maliau Basin Conservation Area, Sandakan Division, State of Sabah, Malaysian Borneo.

Natural history

In the type locality, Camel Trophy, two adult males and a metamorphosing juvenile of the type series were simultaneously found at night perching each on a leaf of low trees (< 1 m) extending above the surface of a shallow pool (3–5 m × 10 m). The air temperature before the time of finding was 24°C. No tadpoles were found in the pond nor eggs on overhanging leaves of trees. Early March may not be a breeding season since males were not calling, but is surely in the season of metamorphosis as evidenced by the presence of a juvenile with a degenerating tail. Frogs found together with the new species included *Rhacophorus borneensis*, *Kurixalus appendiculatus*, *Polypedates macrotis* (Boulenger, 1891), and *Microhyla petrigena* Inger and Frogner, 1979.

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Comparisons

Chiromantis inexpectatus is distinguished from *C. cherrapunjiae* (Roonwal and Kripalani, 1966) from northern India by light brown or yellowish brown dorsum with dark-brown spots, dark-brown dorsolateral stripe bordered below by white stripe, and the presence of inner metatarsal tubercle (vs. dorsum pale green to dark green and inner metatarsal tubercle absent in *C. cherrapunjiae*: Chanda, 1994; Mathew and Sen, 2010); from *C. doriae* from northern India through Myanmar, Thailand, Laos, Cambodia, and Vietnam to China, by the absence of dark dorsal stripes and presence of external vocal sac (vs. dark dorsal stripe present and external vocal sac absent in *C. doriae*); from *C. dudhwaensis* (Ray, 1992) from northern India by the possession of dorsum with dark-brown spots, and third finger disk larger than tympanum (vs. dorsum with dark stripe, and disk on third finger smaller than tympanum in *C. dudhwaensis*); from *C. hansenae* from Thailand by dark-brown dorsolateral stripe bordered below by white streak on anterior half of flank, and clearly webbed second to fourth fingers (vs. dorsolateral stripe cream bordered with violet streaks on each edge to groin, and webs on hand rudimentary in *C. hansenae*: Taylor, 1962); from *C. marginis* Chan et al., 2011 from the Malay Peninsula by dorsolateral stripe dark-brown, bordered below by white streak, both of which not continuous but fading one-half way down body, webbing between third and fourth fingers not extensive (III 2–2.5 IV), and disk on third finger larger than tympanum (vs. dark-brown dorsolateral stripe bordered above by white stripe, both of which continuing to groin, extensive webbing between third and fourth fingers [III 1.5–IV], and third finger disk smaller than tympanum in *C. marginis*: Chan et al., 2011); and from *C. nongkhorensis* from Myanmar, Thailand, Laos, Cambodia, Vietnam, and Malaysia, by smaller body size, relatively small eye shorter than snout, possession of clear dorsolateral stripes and dorsum speckled with small dark-brown spots (vs. body larger, SVL 29–32 mm in males, eye longer than snout, dorsolateral stripes absent, and distinct dark dorsal markings between orbital and sacral regions in *C. nongkhorensis*).

The new species also differs from the following species morphologically: from *C. punctatus* (Wilkinson et al., 2003) from Myanmar by dorsum scattered with vaguely defined small dark-brown spots, and dark-brown dorsolateral stripe bordered ventrally by narrow white stripe extending from snout tip below canthus, through lower eyelid to one-half way down body (vs. dorsum with many clearly defined dark-brown spots, and wide white dorsolateral stripe running from snout above canthus rostralis through upper eyelid to groin, bordered ventrally by narrow dark stripe in *C. punctatus*); from *C. samkosensis* Grismer et al., 2007 from Cambodia by the dorsal ground color of yellow to light brown, distinct white streak below canthus, and possession of disk on third finger larger than tympanum (vs. ground color of dorsum lime-green, no white streak below canthus, and third finger disk slightly smaller than tympanum in *C. samkosensis*: Grismer et al., 2007); from *C. senapatiensis* (Mathew and Sen, 2009) from northern India by the absence of dark dorsal stripe and presence of clear webs on second to fourth fingers (vs. dark middorsal stripe present and webs on hand rudimentary in *C. senapatiensis*: Mathew and Sen, 2010); from *C. shyamrupus* (Chanda and Ghosh, 1989) from northern India by the absence of dark dorsal stripes, and presence of clear webs on second to fourth fingers and inner metatarsal tubercle (vs. a dark middorsal stripe present, fingers free of web, and inner metatarsal tubercle absent in *C. shyamrupus*: Chanda, 1994; Mathew and Sen, 2010); from *C. simus* (Annandale, 1915) from northern India by the smaller body size (male SVL 22 mm) and the absence of uniform tuberculation and dark stripes on dorsum (vs. body larger, SVL 30 mm, and dorsum uniformly tuberculate with dark stripes in *C. simus*: Ahmed et al., 2009); and from *C. vittatus* from northern India through Myanmar, Thailand, Laos, Cambodia, and Vietnam to China, by the smaller body size and presence of dark-brown dorsolateral stripe bordered below by white streak on anterior half of flank (vs. size larger, males 26–28 mm in SVL, and dorsolateral stripe bordered above by white stripe running to groin in *C. vittatus*).

The African species, *C. kelleri* Boettger, 1893 from Ethiopia and Somalia through Kenya to Tanzania, *C. petersii* Boulenger, 1882 from Kenya and Tanzania, *C. rufescens* from West Africa, and *C. xerampelina* from Kenya, Angola and Namibia to South Africa, are all much larger (SVL 35–80 mm: Liem, 1970) than the present new species (ca. 22 mm).

DISCUSSION

The island of Borneo is famous for its high frog diversity, and as many as 155 species have been recorded by the beginning of this century (Matsui, 2006). The number of species is still increasing, and the situation for rhacophorids is no exception. Several new species have been described recently based chiefly on morphological and acoustic data (Dehling, 2008, 2010; Dehling and Grafe, 2008; Matsui, 2009), as well as molecular approaches (Matsui et al., 2013), further contributing to the discovery of the Bornean frog diversity.

Compared with these recent findings, discovery of *Chiromantis* from Borneo Island is biogeographically more significant, since occurrence of the genus has never been expected on the island. However, the finding is not surprising, because another rhacophorid tree frog, *Theloderma horridum* Boulenger, 1903, long known only from the Peninsular Thailand and Malaysia was also discovered from the island rather recently (Inger et al., 1995). Tree frogs are generally more difficult to be detected than frogs and toads of the other lineages because of their habit of spending most of their life on trees, sometimes on high crown, and can mainly be found only in the breeding seasons when they come down to lower places near the water body.

Maliau Basin Conservation Area, where the present new species was found, is situated in the southern part of Sabah, and is not easy of access. The three specimens were obtained during a joint expedition of University Malaysia Sabah (UMS) and Japan International Cooperation Agency (JICA), together with the recently described *Rhacophorus borneensis*, which had been confused with *R. reinwardtii* Schlegel, 1840 (Matsui et al., 2013), suggesting that the region has never been amply surveyed.

Our phylogenetic analyses using limited samples indicated deep genetic divergence among species of *Chiromantis*. Of the Asian species, *C. doriae* and *C. nongkhorensis* formed a well-supported clade with the African taxa, but the other Asian species were much divergent from it, supporting

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the findings of Frost et al. (2006) and Li et al. (2009). The genus is reported to be monophyletic when it is compared with the Indian genus *Ghatixalus* Biju et al., 2008 (Pyron and Wiens, 2011), but further analyses including species from India and those recently described from Southeast Asia are necessary to determine the validity of the monophyly of *Chiromantis*.

The African *C. xerampelina* is noted for the construction of a foamy egg mass (e.g., Noble, 1931), and *C. dorae* and *C. nongkhorensis* also lay eggs in a foamy mass (Taylor, 1962; Fei et al., 2009; M. Matsui, pers. obs.). The Indian member *C. simus* is also reported to lay eggs in a foamy nest (Ahmed et al., 2009). In contrast, *C. vittatus* lays smaller, non-foamy egg mass on leaves (Ahmed et al., 2009; Fei et al., 2009; M. Matsui pers. obs.). Variation in the mode of egg deposition is another interesting problem in understanding phylogeny and evolution in the genus *Chiromantis*.

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