

## A new bush frog (Anura: Rhacophoridae: *Philautus*) from Gunung Mulu National Park, East Malaysia (Borneo)

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**Abstract.** A new bush frog of the *Philautus aurifasciatus* group is described from the montane forest of the karst mountain Gunung Api in the Gunung Mulu National Park, eastern Sarawak, Malaysian Borneo. The new species was hitherto assigned to *Philautus longicrus*, but differs from this species in snout length and shape, head length, hand length, snout proportions including internarial distance and relative position of the nostril, interorbital distance, eye diameter, nuptial pad shape, and the absence of a row of small, low white tubercles along the edge of the lower jaw. The advertisement call of the new species is described and compared to the calls of all other Bornean members of the *P. aurifasciatus* group.

Key words. Amphibia, Anura, Rhacophoridae, *Philautus juliandringi* sp. n., *Philautus longicrus*, Sarawak, Palawan, advertisement call.

### Introduction

The rhacophorid frog genus *Philautus* GISTEL, 1848 contains about 150 species and is distributed from India and Sri Lanka through Indochina to the Greater Sunda Islands and the Philippines (FROST 2009). Currently, 17 species of *Philautus* are known from Borneo (INGER & STUEBING 2005, MATSUI 2009). They are classified into four species groups (DRING 1987), the largest being the *P. aurifasciatus* group (8 species). The species of this group are morphologically quite variable and similar to each other and therefore difficult to distinguish. In his monograph on the Bornean amphibians, INGER (1966) treated *P. acutirostris* (PETERS, 1867) (Philippines), *P. longicrus* (BOULENGER, 1894) (Palawan and possibly Borneo), *P. mjobergi* SMITH, 1925 (Borneo), and *P. petersi* (BOULENGER, 1900) (Peninsular Malaysia and Borneo) as synonyms of one highly variable species, namely *P. aurifasciatus* (SCHLEGEL, 1837), originally described from Java, and considered *P. amoenus* SMITH, 1931 (Borneo) doubtfully distinct. During the joint expedition of the Sarawak Government and the Royal Geographic Society to the Gunung Mulu National Park in Sarawak, Malaysian Borneo in 1977 and 1978, JULIAN DRING collected a number of species of what is now regarded as the *Philautus aurifasciatus* group (DRING 1978, 1987, DRING & KIEW 1982). Among these, he found pairs of sympatric forms that differed in morphology and had distinctive advertisement calls, suggesting their specific distinctness. In his subsequent review of the Bornean members of the genus *Philautus*, DRING (1987) arranged the species into four groups. Within the *P. aurifasciatus* group, he restricted *P. aurifasciatus* to Java, resurrected *P. mjobergi*, *P. petersi*, *P. longicrus*, and *P. acutirostris* (and some other species from outside Borneo), and described

*P. umbra* as a new species. Since then, three more species assigned to the *P. aurifasciatus* group have been described from Borneo (MALKMUS & RIEDE 1996, INGER & STUEBING 1996, MATSUI 2009). Despite DRING's (1987) review, the *P. aurifasciatus* group remains one of the taxonomically most challenging groups of Bornean frogs. DRING (1987) stated that he could only partly revise "this group of confusingly variable species" and that "additional field work is needed to identify the call-types of various populations and to determine the range of morphological variation for each species".

Among the frogs, DRING (1987) reported from Gunung Mulu National Park, was a small *Philautus* species he had collected on Gunung Api. He tentatively assigned it to *P. longicrus*, a species originally described from Palawan, Philippines, even though he already noted significant morphological differences between specimens from Api and Palawan, and stated that "the identification of the Api sample is in doubt, but no available name seems more suitable" (DRING 1987). During field work in the Gunung Mulu National Park, I collected a series of this form from Gunung Api. When I compared it morphologically with *Philautus longicrus* from Palawan, I could not only confirm the differences noted by DRING (1987), but also found many additional ones and concluded that the two forms were not conspecific. Therefore, I formally describe the species from Gunung Api as new to science in the following.

Gunung Mulu National Park is the second largest national park in Sarawak, covering an area of 529 km<sup>2</sup> (HAZEBROEK & KASHIM BIN ABANG MORSHIDI 2006). Including the new species, 16 species of anurans have been described from the park, ten of which are considered endemic (DRING 1983a, 1983b, 1987, KIEW 1984, DUBOIS 1987, INGER et al. 1995, DEHLING 2008).

## Materials and methods

Field work at Gunung Api was conducted during three nights in October and December 2007 and March 2009, respectively. Type specimens were collected at night, photographed in life, euthanised in a chlorobutanol solution the following day, fixed in 10% formalin, and later transferred to 70% ethanol for long-term storage. Liver tissue samples, which were stored in 98% ethanol, were taken from one of the paratypes for later molecular analyses.

From the preserved specimens, I took the following measurements with a digital calliper (to the nearest 0.1 mm): snout–vent length (SVL, from tip of snout to vent); tibia–fibula length (TFL, measured with both knee and tibiotarsal articulation flexed); thigh length (THL, from cloaca to knee); head width (HW, distance between angles of jaw); head length (HL, distance from angle of jaw to tip of snout); horizontal eye diameter (ED); horizontal tympanum diameter (TD); upper eyelid width (EW); interorbital distance (IO, shortest distance between upper eyelids); snout length (SL, distance from anterior margin of eye to tip of snout); eye to nostril distance (EN, distance between anterior margin of eye and centre of nostril); nostril to snout distance (NS, distance between centre of nostril and tip of snout); internarial distance (NN, distance between centres of nostrils); hand length (HND, distance from base of thenar tubercle to tip of third finger); width of disc of third finger (3FW); foot length (FOT, distance from base of inner metatarsal tubercle to tip of fourth toe); width of disc of fourth toe (4TW). The webbing formulae are given as proposed by MYERS & DUELLMAN (1982). Notes on colour in life are based on digital photographs taken in the habitat and on the day following the collection.

For comparisons, I examined museum specimens of several species of *Philautus* (see Appendix). Museum abbreviations used are as follows: Field Museum of Natural History, Chicago, Illinois, USA (FMNH); Naturhistorisches Museum der Burgergemeinde Bern, Switzerland (NMBE); Staatliches Museum für Naturkunde Stuttgart, Germany (SMNS); Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin, Germany (ZMB).

Additional information about morphological characters of *Philautus longicrus* from Palawan was taken from the original description by BOULENGER (1894), the accounts in INGER (1954), DRING (1987), and BROWN & ALCALA (1994), and the detailed description of the lectotype by BOSSUYT & DUBOIS (2001). Sources of data on morphological characters and distribution of other species of *Philautus* include the following works: BOULENGER (1882), TAYLOR (1920, 1922), INGER (1954), TAYLOR (1962), INGER (1966), DRING (1987), INGER (1989), BROWN & ALCALA (1994), INGER et al. (1995), MALKMUS & RIEDE (1996), INGER & STUEBING (1996), STUEBING & WONG (2000), MALKMUS et al. (2002), and MATSUI (2009).

Advertisement calls of two of the paratypes and 13 non-collected specimens were recorded in the natural habitat using a Sony WM-D6C stereo cassette recorder and a Sony ECM-S959C microphone. Air temperature was 18.3–19.1°C during recordings. The recordings were digitized at 44.1 kHz with 16 bit-resolution and analyzed using Syrinx 2.6h

sound analysis software (John Burt, [www.syrinxpc.com](http://www.syrinxpc.com)) and Adobe Audition 1.5 software.

## Systematics

### *Philautus juliandringi* sp. n.

(Figs. 1–5)

Holotype: NMBE 1056438, adult male, from the Pinnacles Trail (04°07' N, 114°53' E), northern slope of Gunung Api, approx. 1100 m above sea level, Gunung Mulu National Park, Miri Division, Sarawak, Malaysia, collected by J. M. DEHLING on 14 March 2009.

Paratopotypes: NMBE 1056439, adult male, collected with the holotype; SMNS 13625–627, three adult males, collected on 24 October 2007, otherwise same data as for holotype.

Diagnosis: A species of the *Philautus aurifasciatus* group, distinguishable from its congeners by the combination of the following characters: (1) small size, SVL of adult males less than 20.1 mm; (2) legs long, tibiotarsal articulation reaching far beyond tip of snout; (3) cutaneous pectoris muscle present; (4) vomerine teeth absent; (5) snout rounded in dorsal view, obtuse in profile, without rostral cone; (6) interorbital distance greater than upper eyelid width and internarial distance; (7) median lingual process absent; (8) heel without dermal appendage; (9) smooth nuptial pads present; (10) toes half-webbed; (11) dorsum brownish-yellow with faint markings during the night, light brown with darker markings during the day; (12) anterolateral surfaces of thighs, groin and flanks largely unpigmented with bright yellow markings in life; (13) iris golden brown in life; (14) advertisement call consisting of a single note with 5 or 6 pulses and an energy maximum at about 3200 Hz.

Description of the holotype: Body moderately stout; head large (HL/SVL 0.33), wider than trunk and wider than long (HW/HL 1.20); body widest at temporal region, tapering to groin; snout as long as eye diameter (SL/ED 1.01), rounded in dorsal view, obtuse in profile, projecting slightly, without rostral cone; canthus rostralis moderately distinct, almost straight-lined between nostril and eye in profile, concave in dorsal view, slightly constricted behind nostrils; loreal region oblique, sloping, slightly concave; nostrils situated in protuberance, closer to tip of snout than to eye (EN/NS 1.52); internarial distance less than distance from eye to nostril (NN/EN 0.83); eyes directed anterolaterally, protruding, large (ED/HL 0.52); pupil horizontal; interorbital distance greater than upper eyelid width (IO/EW 1.17) and internarial distance (IO/NN 1.21); tympanum covered with skin, separated from orbit by less than one-third of its diameter; tympanum diameter about one-third of eye diameter (TD/ED 0.35); maxillary teeth very small and low; vomerine teeth absent; tongue narrow, elongate, bifurcated at base, and free for about two-thirds of its length; median lingual process absent; vocal sac median, subgular; apertures of vocal sac longitudinal, located far laterally on both sides of floor of mouth.





Figure 1. Dorsal view (left) and ventral view (right) of the preserved holotype of *Philautus juliandringi* sp. n. (NMBE 1056438). Scale bar = 10 mm.

Dorsal surfaces shagreened or rugose, with scattered small, low tubercles; chin, chest, abdomen, and ventral side of thighs and arms coarsely granular; flanks of body, lateral surfaces of thighs, and ventral side of lower legs smooth; supratympanic fold distinct, slightly curved, extending from posterior edge of upper eyelid to scapula region; heel without dermal appendages; supracloacal region unornamented, without ridge, flap or fold.

Arms stout; tips of fingers enlarged into broad oval discs, each with circummarginal groove; disc of Finger III as wide as disc of Finger IV, slightly wider than tympanum (FDW/TD 1.06); relative length of fingers:  $I < II < IV < III$ ; subarticular tubercles rounded, prominent, numbering

one on Fingers I and II and two on Fingers III and IV, with proximal tubercles being much smaller than distal ones; fingers without webbing (Fig. 3); no dermal flap or fringe on postaxial edge of Finger IV; thenar tubercle oval, small, about one-fifth of base of Finger I; inner palmar tubercle small, very low, no outer one; nuptial pad on dorsal side of base of Finger I small, low, smooth, lacking fine spines.

Legs sturdy, very long (TFL/SVL 0.62); tibia-fibula longer than thigh (TFL/THL 1.08); heels overlapping each other considerably with legs folded at right angle to body; knee reaching scapula region; tibiotarsal articulation reaching far beyond tip of snout; heel without dermal appendages; relative length of toes  $I < II < III < V < IV$ ; tips of toes enlarged into broad discs, slightly smaller than those of fingers; sub-articular tubercles rounded, prominent, numbering one on Toes I and II, and two on Toes II, IV, and V; toes half-webbed, formula being  $I_2-2.5II_{1.5-3}III_2-2^{+}IV_2^{+}-2V$  (Fig. 3); distal portion of metatarsals separated by webbing; inner metatarsal tubercle oval, prominent, moderately large (length 1.0 mm), no outer one; few supernumerary small tubercles on metatarsals; narrow, low dermal fringe on postaxial edge of Toe V from base of metatarsus to disc.

Measurements (in mm): SVL 19.7; TFL 12.2; THL 11.3; HW 7.9; HL 6.6; ED 3.4; TD 1.2; EW 2.0; IO 2.4; EN 2.0; NS 1.5; NN 2.0; 3FW 1.3; HND 6.0; FOT 9.0.

Dorsal colouration in life varied strikingly between night and daytime (cf. Fig. 2). During the night, dorsum brownish-yellow with faint markings; light brown stripes along the canthus rostralis and between the eyes; two longitudinal, paravertebral stripes on the back; limbs with faint crossbars. During the day, dorsum light brown with darker markings; sides of the head below canthus rostralis, eye, and supratympanic fold almost uniformly dark brown; interorbital stripe, crossbars on limbs, and stripes on the back darker and wider than during the night. Chin, throat, chest, venter, and ventral surfaces of limbs cream-coloured, speckled with light brown, irregularly shaped spots. Anterolateral surfaces of thighs, groin, and flanks largely unpigmented with bright yellow markings. Iris golden brown. In preservative, dorsal pattern and colouration similar to daytime colouration. Yellow markings on thighs, groin, and flanks faded to white.



Figure 2. Paratopotype of *Philautus juliandringi* sp. n. (SMNS 13625) in life, during the night (left) and during the day (right).

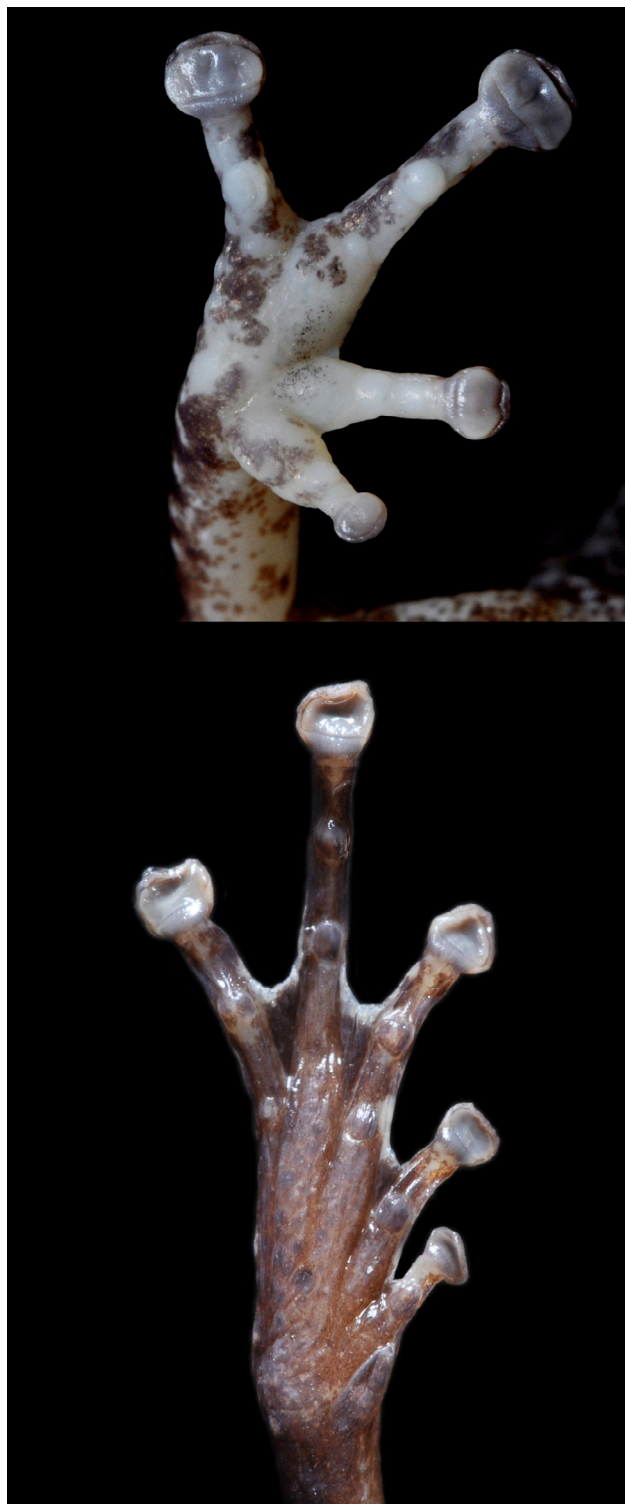


Figure 3. Volar view of the right hand (top) and plantar view of the right foot (bottom) of a preserved paratype of *Philautus juliandringi* sp. n. (SMNS 13625).

**Variation:** The paratypes are very similar to the holotype in measurements and proportions (Table 1). Variation of pedal webbing is expressed as  $I_2-2.5II(1.5-2^-)-3III_2-2^+IV(2^+-2)-2V$ . All paratypes have a median subgular vocal sac and small, smooth, low nuptial pads. Dorsal pattern varies slightly. In one paratype, the longitudinal stripes on the back are very narrow. The mottling on the ventral side is

variable (Fig. 4). In life, all paratypes had a yellow colouration on thighs, groin, and flanks, the variation of which is shown in Fig. 5. Ranges of measurements of type series (in mm): SVL 18.9–20.1; TFL 11.6–12.2; THL 10.4–11.3; HW 7.7–8.4; HL 6.2–7.0; ED 3.0–3.6; TD 1.0–1.2; EW 1.9–2.0; IO 2.3–2.4; EN 2.0–2.1; NS 1.4–1.5; NN 2.0–2.1; 3FW 1.2–1.3; HND 5.9–6.2; FOT 8.6–9.0.

**Advertisement call:** I heard the species calling only after dusk. Calls were emitted at irregular intervals of between three seconds and several minutes. Fifty-eight advertisement calls of 15 specimens including two paratypes were analyzed. The typical advertisement call consists of a single note, composed of 5 or 6 ( $5.5 \pm 1.2$ , range 2–9) pulses and lasting  $410 \pm 111$  (234–658) ms. In 60 percent of the calls, the note was followed by a single additional pulse after an interval of  $402 \pm 122$  (265–2678) ms (Fig. 7). In five of these calls, a second additional pulse was added after another interval of  $431 \pm 146$  (291–603) ms. Pulse repetition rate in the main note ranged between 10.3 and 16.7 ( $12.6 \pm 1.6$ ) per second. It was highest in the beginning of the note and decreased towards the end. Calls were intensity-modulated. Amplitude of the pulses increased from the beginning to the end of the note. The amplitude of the additional pulse was slightly higher than the amplitude of the last pulse of the main note (Fig. 7). The main note was slightly frequency-modulated and the first one or two pulses usually had a lower frequency (energy maximum at  $2725 \pm 126$  [2550–2900] Hz) than the rest of the pulses (energy maximum at  $3188 \pm 156$  [2855–3520] Hz). The frequency of the additional single pulses was as high as the frequency of the pulses in the middle or at the end of the main note.

**Distribution and ecology:** So far, *Philautus juliandringi* is known with certainty only from its type locality Gunung Api, a karst peak reaching 1710 m a.s.l. Gunung Api is separated from other peaks of the Melinau limestone by deep river gorges. It is possible that *P. juliandringi* also occurs on one of these other karst peaks, most likely on Gunung Benarat (1615 m a.s.l.), but all these peaks are hardly accessible and have therefore not yet been surveyed faunistically. Because of the karst character of Gunung Api, there are no open water bodies like streams or ponds. Therefore, only five frog species are known to occur in the montane area (above 800 m a.s.l.) of this mountain (DRING 1987, pers. obs.).

The type specimens were collected in montane shrub, calling from leaves at heights of 1.5–2.0 m. Descending from the lower peak of Gunung Api, I heard the call of *P. juliandringi* in montane shrub and forest between 900 and 1200 m a.s.l. and occasionally in submontane forest down to 700 m a.s.l. Below this altitude, the call was replaced by that of *P. tectus*.

*Philautus juliandringi* occurs sympatrically with *P. umbra*, another endemic of Gunung Api, which can be found between 800 and at least 1200 m a.s.l. (DRING 1987, DEHLING 2009). As DRING (1987) already noted, both species have rattling calls, which are quite similar to each other. They can often be heard calling at the same sites. Other sympatric species are *Pelophryne api* DRING, 1983, *Kalophrynus punctatus* PETERS, 1871, and *Philautus kerangae* DRING, 1987.





Figure 4. Variation of ventral colouration in *Philautus juliandringi* sp. n. in life (left: SMNS 13625, right: SMNS 13627).

Table 1. Body proportions of the male type specimens of *Philautus juliandringi* and male topotypic *Philautus longicrus* (n=5) from Palawan. Mean values are followed by ranges and values taken from the literature (in parentheses; D: DRING 1987, BA: BROWN & ALCALA 1994, BD: BOSSUYT & DUBOIS 2001).

	TFL/SVL	HL/SVL	HW/SVL	HW/HL	NN/EN
<i>Philautus juliandringi</i>	0.60 0.58–0.62 (D 0.59–0.63)	0.33 0.31–0.35	0.40 0.38–0.42 (D 0.38–0.42)	1.21 1.19–1.25	0.95 0.83–1.00 (D 0.96–1.05)
<i>Philautus longicrus</i>	0.60 0.57–0.62 (BA 0.57–0.64) (D 0.61–0.64) (BD 0.65)	0.36 0.34–0.39 (BD 0.38)	0.41 0.39–0.42 (D 0.40–0.43) (BA 0.39–0.44)	1.12 1.08–1.16 (BA 1.06–1.17) (BD 1.09)	1.18 1.09–1.26 (D 1.11–1.26)
	NN/HW	EN/NS	IO/EN	IO/EW	IO/ED
<i>Philautus juliandringi</i>	0.25 0.25–0.26	1.46 1.39–1.52	1.11 1.01–1.18	1.19 1.16–1.23	0.73 0.68–0.80
<i>Philautus longicrus</i>	0.27 0.26–0.29	1.13 1.07–1.18	1.35 1.29–1.42	1.30 1.25–1.34 (BD 1.33)	0.84 0.77–0.88
	SL/HW	SL/ED	ED/HL	HND/SVL	
<i>Philautus juliandringi</i>	0.39 0.36–0.44	0.97 0.92–1.05	0.49 0.46–0.52	0.31 (0.30–0.31)	
<i>Philautus longicrus</i>	0.45 0.43–0.46	1.20 1.13–1.29	0.42 0.40–0.45	0.28 (0.26–0.29)	

**Etymology:** The species is named after the British biologist JULIAN CHRISTOPHER MARK DRING, in honour of his valuable contributions to the knowledge of the genus *Philautus* and the amphibians of the Gunung Mulu National Park.

**Comparisons:** The small size, the absence of vomerine teeth, the presence of the musculus cutaneus pectoris, and the small, smooth nuptial pads place *Philautus juliandringi* in the *P. aurifasciatus* group. It is thus distinguished from





Figure 5. Variation of thigh, groin, and flank colouration in *Philautus juliandringi* sp. n. in life (top to bottom: SMNS 13627, 13626, 13625, respectively).

the species of the *P. hosii* group, *P. hosii* (BOULENGER, 1895) and *P. ingeri* DRING, 1987, which have vomerine teeth, lack nuptial pads, and are much larger. The Bornean species and subspecies of the *P. vermiculatus* group (*P. acutus* DRING, 1987, *P. a. aurantium* INGER, 1989, *P. a. gunungensis* MALKMUS & RIEDE, 1996, *P. bunitus* INGER, STUEBING & TAN, 1995, *P. discregus* INGER, 1989, *P. erythrophthalmus* STUEBING & WONG, 2000, *P. kerangae* DRING, 1987) are larger than *P. juliandringi* and lack nuptial pads and the musculus cutaneus pectoris. *Philautus tectus* DRING, 1987, the sole member of the *P. tectus* group, is larger (males 20.8–23.4 mm) than *P. juliandringi*, lacks the musculus cutaneus pectoris, has spinose nuptial pads, a strongly curved canthus rostralis, and deeply concave lores.

Additionally, all aforementioned species can be distinguished from *P. juliandringi* by their strongly differing advertisement calls (DRING 1987, MALKMUS & RIEDE 1996, MALKMUS et al. 2002, own unpubl. data), except *P. discregus* and *P. erythrophthalmus*, whose calls are unknown.

The advertisement call of *Philautus juliandringi* is more similar to those of the other Bornean species of the *P. auri-*

*fasciatus* group in being pulsed and only slightly frequency-modulated. However, the calls of all other Bornean species of the *P. aurifasciatus* group differ in main characteristics (in parentheses: number of notes, note length, number of pulses, dominant frequency, respectively), and can thus be used to distinguish these species from *P. juliandringi*: *P. amoenus* (2–3 notes, 110 ms, 3–4 pulses, 1800 Hz; MALKMUS & RIEDE 1996, MALKMUS et al. 2002); *P. davidlabangi* MATSUI, 2009 (1 note, 50–80 ms, 13–18 pulses, 2875–3300 Hz; MATSUI 2009, own unpubl. data); *P. mjobergi* (call series of 1–4 calls, calls consisting of 1–11 notes, 20–70 ms, 2–7 pulses, 2000–2800 Hz; DRING 1987); *P. petersi* (1 note, 1180–1300 ms, 51–56 pulses, 1600–2200 Hz; DRING 1987); *P. refugii* INGER & STUEBING, 1996 (1–3 notes, 10–20 ms, 2–5 pulses, 3500–4000 Hz; own unpubl. data); *P. saueri* MALKMUS & RIEDE, 1996 (2–4[5] notes, 30–40 ms, 7–8 pulses, 1900–2600 Hz; MALKMUS & RIEDE 1996, MALKMUS et al. 2002); *P. umbra* (1 note, 120–587 ms, 2–11 pulses, 1400–2100 Hz; own unpubl. data).

In addition to the bioacoustic differences, species of the *P. aurifasciatus* group from Borneo differ in the following morphological characters (characters of *P. juliandringi* in parentheses): *Philautus amoenus* is larger, SVL of males 21.6–24.2 mm (up to 20.1 mm), has shorter legs with TFL/SVL 0.47–0.54 in males (0.58–0.62), the tibiotarsal articulation reaching to tip of snout or slightly beyond (reaching considerably beyond tip of snout), and has a wider head, HW/SVL 0.40–0.47 (0.38–0.42). *Philautus davidlabangi* has a longer head, HL/SVL 0.40–0.43 (0.31–0.35), shorter legs with TFL/SVL 0.52–0.56 (0.58–0.63), and lacks nuptial pads. *Philautus mjobergi* has a wider head with HW/SVL 0.39–0.49 (0.38–0.42), a median lingual process (absent), is larger, SVL of males up to 24.1 mm (up to 20.1 mm), has distinct rudiments of webbing between fingers (absent), but less developed webbing between toes. *Philautus petersi* is larger, SVL of males 20.4–26.8 mm (up to 20.1 mm), has a wider head with HW/SVL 0.40–0.48 (0.38–0.42), shorter legs with the tibiotarsal articulation reaching to tip of snout only (reaches beyond tip of snout), distinct web rudiments between the fingers (absent), a median lingual process (absent) and small, conical tubercles on postaxial edge of forearm and tarsus, upper eyelid, heel, and below the jaw (absent). *Philautus refugii* is smaller, SVL of males 15.3–18.0 mm (17.5–20.1 mm), has an obtusely pointed snout in dorsal outline (rounded), the interorbital distance as wide as the upper eyelid (wider than upper eyelid), more extensively webbed toes, and a conical tubercle at the tibiotarsal joint, followed by a row of lower tubercles along the postaxial edge of the tarsus and fifth toe (absent), the anterior face of thigh has a barred black and white pattern (unpigmented with bright yellow spots), and females have a rostral cone (absent). *Philautus saueri* has shorter legs, TFL/SVL 0.54 (0.58–0.63), a wider head, HW/SVL 0.44 (0.38–0.42), a larger interorbital distance with IO/EW 1.90 (1.16–1.23), the nostril situated between the eye and the tip of snout, EN/NS 1.01 (1.39–1.52), and a small tubercle at the tibiotarsal joint (absent). *Philautus umbra* is larger, SVL of males up to 35.1 mm (up to 21.1 mm), has a median lingual process (absent), less developed toe webbing, and broader finger and toe tips, is light grey with darker markings during the night and almost uniformly black during the day (brownish-yellow at night, light brown with darker mark-





Figure 6. Snout shape of *Philautus juliandringi* sp. n. (left, SMNS 13625) and topotypic *Philautus longicrus* from Palawan (right, FMNH 51340).

ings during the day), and has the nuptial pads reduced to glandular patches (small, distinct, rounded nuptial pads).

*Philautus juliandringi* can be separated from the other species of the *P. aurifasciatus* group with a type locality outside Borneo by the following characters: *Philautus acutirostris* (including its synonyms *P. basilanensis* TAYLOR, 1922 and *P. woodi* STEJNEGER, 1905) from the Philippines has a sharply pointed snout (rounded), frequently with a pale-coloured projection at tip (absent), a median lingual process (absent), a series of glandular tubercles along the edge and a prominent tubercle on the tip of the lower jaw (absent), a row of tubercles on the postaxial edge of the forearm (absent), and vomerine teeth (absent). *Philautus aurifasciatus* from Java has shorter legs, TFL/SVL 0.49–0.58 (0.58–0.63), the tibiotarsal articulation reaching the nostril or the tip of snout (reaches considerably beyond tip of snout), and has an NN/EN ratio of 1.11–1.32 (0.83–1.05). *Philautus leitensis* (BOULENGER, 1897) from the Philippines has a relatively narrower head with HW/HL 1.03–1.17 (1.19–

1.25), more extensively webbed toes, a prominent tubercle at the tibiotarsal articulation (absent), and a row of low, whitish tubercles along the border of the lower jaw (absent). *Philautus schmackeri* (Boettger, 1892) (including *P. mindorensis* [BOULENGER, 1897]) from the Philippines has a relatively narrower head with HW/HL 1.00–1.11 (1.19–1.25), a pointed snout with a conical tip (rounded without conical tip), and shorter legs with TFL/SVL 0.53–0.60 (0.58–0.63). *Philautus parvulus* (BOULENGER, 1893) from Myanmar, Thailand, Cambodia, Vietnam, and Peninsular Malaysia has shorter legs with TFL/SVL 0.44–0.51 (0.58–0.63), and the tibiotarsal articulation reaching the posterior margin of eye (beyond tip of snout), the heels barely touch when legs are folded at a right angle to the body (overlap considerably), and its call consists of 1–7 single-pulsed notes, each lasting 20–40 ms (HEYER 1971).

*Philautus juliandringi* had been assigned to *P. longicrus* from Palawan by DRING (1987) who stated, however, that “the identification of the Api sample is in doubt, but no

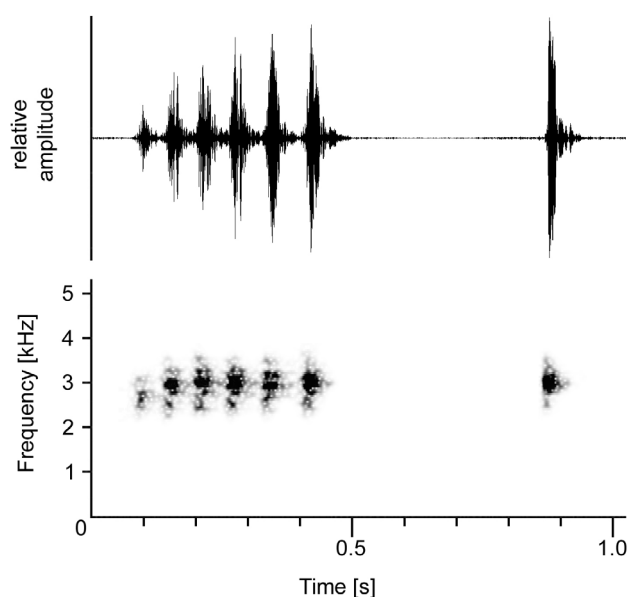


Figure 7. Waveform (top) and corresponding audiospectrogram (bottom) of a typical advertisement call of *Philautus juliandringi* sp.n.

available name seems more suitable". *Philautus juliandringi* differs from specimens of *Philautus longicrus* from Palawan including the type specimens in many morphological characters including head size and snout shape and proportions (Fig. 6; Table 1): In *Philautus longicrus*, the head is longer in relation to SVL and to HW; the internarial distance is larger than the distance from eye to nostril (shorter or equal), and larger in relation to head width; the nostril is situated a little closer to the tip of snout than to the eye (much closer to tip of snout than to eye); the interorbital distance is considerably larger than the distance from eye to nostril (slightly larger or equal), larger in relation to the width of the upper eyelid, and larger in relation to the eye diameter; the eye diameter is smaller in relation to head length; the snout is longer than the eye diameter (equals eye diameter) and relatively larger in relation to head width. The hand is relatively shorter. The snout is almost pointed in dorsal view (rounded) and projects conspicuously beyond the lower jaw in profile (obtuse in profile, projecting only slightly) (Fig. 6). The nuptial pads are more prominent and about as large as the disc of Finger I (smaller), the disc of Finger I is only slightly wider than the penultimate phalanx of the finger (1.6 times the width of penultimate phalanx), and a row of small, low white tubercles is present along the edge of the lower jaw (absent). In life, the lateral surfaces of the hind limbs are light brown (largely unpigmented with bright yellow markings).

Additionally, there seem to be ecological differences as well. According to BROWN & ALCALA (1994), Palawan *P. longicrus* are primarily terrestrial with 92 percent of the specimens collected on the forest floor, whereas all specimens of *P. juliandringi* were observed perching on leaves more than 1 m above the ground.

Remarks: As *Philautus juliandringi* is distinct from *P. longicrus*, the question arises to which species the other

Bornean populations belong that have been referred to as *P. longicrus*. *Philautus longicrus* was described by BOULENGER (1894) based on three specimens collected by ALFRED EVERETT on Palawan. No further specimens had been collected, until the species was first reported from Borneo by SMITH (1925) who referred to two specimens, which had been collected by ERIC MjöBERG at 3000 ft. (913 m a.s.l.) on Mount Poi (today Gunung Pueh; 01°46' N, 109°41'E) in western Sarawak between October and December 1923. SMITH (1925) did not compare his specimens to the types from Palawan but only stated that they agreed "well with the description of the frog". However, given the close morphological resemblance of the species of the *P. aurifasciatus* group, BOULENGER's (1894) description contains only few diagnostic characters. The whereabouts of the specimens from Gunung Pueh are unclear and I was not able to examine them. According to the characters mentioned by SMITH (1925) they could belong to either *P. longicrus* or *P. juliandringi*, or another long-legged species from western Sarawak that is close to *P. juliandringi* and currently being described (DEHLING et al. in prep.).

Subsequent to SMITH's (1925) paper, no further specimens assigned to *P. longicrus* were reported from Borneo until DRING (1987) doubtfully used this name for the species from Gunung Api which is herein described as *P. juliandringi*. After DRING (1987), *P. longicrus* was first included in the anuran fauna of Sabah by INGER & STUEBING (1989), though without precise locality data, and later listed for Gunung Kinabalu by the same authors based on specimens from the Sabah Parks collection (INGER & STUEBING 1992, INGER et al. 1996). Later, it was also recorded from the Crocker Range in Sabah (INGER et al. 2000). I examined voucher specimens assigned to *P. longicrus* from Gunung Kinabalu, the Crocker Range, and another locality in Sabah, the Mendolong Camp in the Sipitang District (04°45' N, 115°40' E; STUEBING 1991), all collected by the authors of the aforementioned records, and compared them to *P. juliandringi* and *P. longicrus* from Palawan. The sample from the Mendolong Camp represents a stout, long-legged species which is similar to *P. juliandringi* and about the same size (SVL of males with nuptial pads 18.5–20.0 mm, female 23.3 mm), but has a more pointed snout and more extensively webbed toes, and therefore cannot unambiguously be assigned to *P. juliandringi*. The sample from Gunung Kinabalu seems to belong to the same species as that from the Crocker Range. It is another long-legged, however very small species (SVL of males with nuptial pads 14.0–17.3 mm, SVL of females with enlarged oviducts 21.0–21.5 mm) with a moderately protruding, acuminate snout, a wider and shorter head than both *P. juliandringi* and *P. longicrus*, and might represent a yet undescribed species. To finally clarify the taxonomic status of these populations and to facilitate identification in the field more material needs to be collected together with additional data including information about bioacoustics and colouration in life.

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**Appendix**

## Comparative material examined

*Philautus acutus*: Camp 3 (N 04° 02.284', E 114° 53.285'), Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056429–433).

*Philautus amoenus*: Gunung Kinabalu, Sabah, Malaysia (ZMB 53652–653, 53695, 49019).

*Philautus davidlabangi*: Batang Ai Hilton Resort (N 01°09.477', E 111°55.467'), Batang Ai National Park, Sarawak, Malaysia (NMBE 1056444).

*Philautus hosii*: Camp 5, Gunung Mulu National Park, Sarawak, Malaysia (SMNS 13628–29).

*Philautus ingeri*: Camp 3 (N 04° 02.284', E 114° 53.285'), Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056435–436).

*Philautus kerangae*: Mentawai Ranger Station, Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056437).

*Philautus longicrus*: Brooke's Point, S slope Mt. Balabag, 2800 ft., Palawan, Philippines (FMNH 51339–340), Brooke's Point, S slope Mt. Balabag, 5100 ft., Palawan, Philippines (FMNH 51342, –345, –347, –350, –352, –355, –358), Brooke's Point, S slope Mt. Balabag, 4000 ft., Palawan, Philippines (FMNH 51357).

*Philautus "longicrus"* (incertae sedis): Silau–Silau trail, near headquarters, Mt. Kinabalu National Park, Ranau District, Sabah, Malaysia (FMNH 231109–110); Mt. Kinabalu National Park, Sabah, Malaysia (FMNH 235014), Mendolong, Sipitang District, Sabah, Malaysia (FMNH 235015, 239289–290, –302, –303, –307, –308, 242504), Sunsuron Camp, Crocker Range National Park, Tambunan District, Sabah, Malaysia (FMNH 252391–394, 252396–400, –407).

*Philautus mjobergi*: Camp 3 (N 04° 02.284', E 114° 53.285'), Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056434).

*Philautus petersi*: Camp 3 (N 04° 02.284', E 114° 53.285'), Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056440, 1056441, 1056442, 1056443), Sarawak (ZMB 7145).

*Philautus refugii*: Western Sarawak, Malaysia (JMD field numbers –459, –460, –464, –465, –468, –473, –476, –482, –487, –489).

*Philautus saueri*: east of Pakka Cave (3050 m), SW-slope of Mount Kinabalu, Sabah, Malaysia (ZMB 53626; holotype).

*Philautus tectus*: Dear cave trail, near Sungai Melinau Paku, Headquarters, Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056450–451); Camp 5, base of Gunung Api, Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056452), Bako National Park, Sarawak, Malaysia (NMBE 1056558).

*Philautus umbra*: Pinnacles trail, Gunung Api, Gunung Mulu National Park, Sarawak, Malaysia (NMBE 1056453–456).