

## TWO NEW SPECIES OF *PELOPHRYNE* (ANURA: BUFOIDAE) FROM GUNUNG MURUD, SARAWAK (NORTHWESTERN BORNEO)

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**ABSTRACT.** – Two new species of bufonids of the genus *Pelophryne* are described from the Gunung Murud region of northern Sarawak State, Malaysian Borneo. *Pelophryne murudensis*, new species, adult males to 25.6 mm SVL, finger tips not wider than basal phalanges, finger tips not wider than basal phalanges, snout oblique, absence of a free phalange on Finger I, subarticular tubercles distinct, mandibular spines absent and nuptial pads absent. *Pelophryne linanitensis*, new species, adult males to 18.6 mm SVL, finger tips not wider than basal phalanges, snout vertical, absence of a free phalange on Finger I, webbing to tip of Toe V, subarticular tubercles distinct, mandibular spines absent, presence of a dark hour-glass pattern on dorsum and pale flank stripes.

**KEY WORDS.** – Systematics, new species, *Pelophryne murudensis*, *Pelophryne linanitensis*, Gunung Murud, Batu Linanit, Borneo.

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### INTRODUCTION

The bufonid genus *Pelophryne* Barbour, 1938 (type species: *Pelophryne albotaeniata* Barbour, 1938) contains at least eight nominal species that are currently considered valid, and is widespread in Southeast Asia, including Peninsular Malaysia, Borneo and the Philippine Archipelago (Inger, 1960; Frost, 1985; Duellman, 1993; Inger & Tan, 1996; Malkmus, 1996; Glaw et al., 2000; Iskandar & Colijn, 2000: 22–23). Five species of the genus have been listed from Borneo by Frost (2007), including *P. api* Dring, 1983 (from Gunung Mulu, Sarawak); *P. guentheri* (Boulenger, 1882) (from Gunung Matang and Mulu, Sarawak); *P. misera* (Mocquard, 1890) (from Gunung Kinabalu, Sabah, with a recent report from Kalimantan Timur; Veith et al., 2004); *P. rhopophilus* Inger & Stuebing, 1996 (from Bukit Lanjak, Sarawak as well as Gunung Damus, Sambas, Kalimantan Barat) and *P. signata* (Boulenger, 1895) (from lowland sites in Sarawak and Kalimantan). Two additional names based on Bornean samples, *P. exigua* Boettger, 1901 (from Sungei Baram, Sarawak) and *P. macrotis* Boulenger, 1895 (from Sungei Akah, Sarawak) have been listed as valid by Malkmus et al. (2002: 84). The validity of these species, however, are in suspect: the former has been treated as a synonym of *P. signata* by Frost (2007), the latter as a synonym of *P. guentheri* by Inger (1966: 81) and Inger & Stuebing (1996).

One additional species has been mentioned as occurring on

Borneo in the literature. *Pelophryne brevipes* (Peters, 1867), listed in Inger (1966) and Inger & Tan (1996), which was considered a Philippine Archipelago endemic (type locality: Zamboanga, in Mindanao) by Inger & Stuebing (1997: 89), who allocated Bornean populations formerly assigned to this nominal species to *signata*. Iskandar & Colijn (2000: 22) mentioned that *P. brevipes* is also found in “Peninsular Malaysia, Singapore, Sumatra, Borneo, Siberut and Mindanao”, but for *P. signata*, after listing the type locality as “Aor Island” (= Pulau Aor, off the east coast of Peninsular Malaysia), rather than “Robong Mt., Kapuas district, Dutch Borneo” (= Gunung Rabong, Kapuas, Kalimantan Barat, Indonesia) as in Boulenger’s (“1894” 1895) original description, gave the range of the species as “Borneo”. This nominal species is also known from Singapore (Lim, 1990: as *P. brevipes*).

Thus, while Borneo appears to be the main centre of distribution and diversification within the genus, three extra-Bornean species of *Pelophryne* are known, all from the Philippines: *P. albotaeniata* Barbour, 1938 (from Palawan); *P. brevipes* (Peters, 1867: Zamboanga, Mindanao) and *P. lighti* (Taylor, 1920: from Mindanao and Bohol).

In this paper, I describe two new species of the genus from Gunung Murud, Sarawak’s highest mountain, in northwestern Borneo. The species contained within the genus are recognisable in showing the following suite of characters (see Inger, 1960; 1966; Malkmus et al., 2002): small adult size

(SVL < 31 mm); limbs slender; phalanges reduced; hands and feet with fleshy webbing; tympanum visible; parotoid glands absent; scattered warts on forehead and dorsum; males with subgular vocal sacs and arboreal habits.

Smith (1925) recorded *Pelophryne misera* (as *Nectophryne misera*) from “near the top of the mountain”, based on the collections made by Eric Georg Mjöberg (1882–1938), Curator of the Sarawak Museum, who conducted an expedition to Gunung Murud in 1922 (described in Mjöberg, 1925), his largest specimen measuring 23 mm (SVL). This nominal species is otherwise only known from elevations of 1,450–3,100 m asl on Gunung Kinabalu, Sabah (Malkmus et al., 2002: 86), as well as Gunung Trus Madi, Sabah (BMNH 1982.278), but Smith’s (1925) record of the species from the Gunung Murud massif has been considered valid in the literature (e.g., Inger & Stuebing, 1997: 88; Malkmus et al., 2002: 87). These specimens have not been located in the collections of the BMNH (D. Gower, in litt., 3 January 2005), but a series in the Sarawak Museum (SM D.a.3.1.1), Kuching, the second repositories of material from the Mjöberg expedition bears data associating them with the Gunung Murud Expedition of 1922. Examination of these specimens reveal them to belong to a hitherto unnamed species, here being described primarily on the basis of additional material collected from Gunung Murud in 2003. *Pelophryne misera* is consequently removed from the fauna of Gunung Murud. Several other herpetological novelties were also collected from this mountain range (see Das, 2005).

## MATERIALS AND METHODS

Geographic coordinates for localities were taken with a Garmin Vista™ Geographic Positioning System (datum: wgs 84). The type series were found exposed on vegetation at night, many of them calling. They were photographed in life, euthanised using a chlorobutanol solution, fixed in formalin for a week, and subsequently washed in water and transferred to 70% ethanol for long-term storage. The following measurements were taken with Mitutoyo™ dial calipers (to the nearest 0.1 mm), ca. 35 months after collection: snout-vent length (SVL, from tip of snout to vent); tibia length (TBL, distance between surface of knee to surface of heel, with both tibia and tarsus flexed); head length (HL, distance between angle of jaws and snout-tip); head width (HW, measured at angle of jaws); head depth (HD, greatest depth of head, taken posterior of the orbital region); eye diameter (ED, horizontal diameter of the eyes); interorbital distance (IO, least distance between upper eyelids); internarial distance (IN, distance between nostrils); eye to snout distance (E-S, distance between anterior-most point of eyes and tip of snout); eye to nostril distance (E-N, distance between anterior-most point of eyes and nostrils); axilla to groin distance (A-G, distance between posterior edge of forelimb at its insertion to body to anterior edge of hindlimb at its insertion to body) and body width (BW, greatest width of body). Means are given  $\pm 1$  standard error (SE).

Colour notes on live specimens were taken from scanned

images generated from Fujichrome Velvia 50 ASA slide transparencies; colour nomenclature follows the swatches of Smithe (1975; 1981).

Comparative material examined are listed in Appendix I. Sources of additional data on character states and distribution of congeneric species include the following works: Barbour (1938), Berry (1975), Boulenger (“1894” 1895, 1912), Dring (1983), Inger (1954, 1966), Inger & Stuebing (1996, 1997, 2005), Manthey & Grossmann (1997), Malkmus et al. (2002) and Taylor (1920). Museum abbreviations, where available (indicated with an asterisk), follow Leviton et al. (1985). These include: Brunei Museums Department, Bandar Seri Begawan, Brunei Darussalam (BM); The Natural History Museum, London, U.K. (BMNH\*), Sarawak Biodiversity Centre, Semenggoh, Sarawak, Malaysia (SBC); Sarawak Museum, Kuching, Malaysia (SM\*), Sabah Parks Zoological Museum, Gunung Kinabalu Park, Sabah, Malaysia (SP), Zoological Museum of the Department of Biology, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam (UBD), Museum of Zoology, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia (UNIMAS) and the Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC; the abbreviation used in Leviton et al., 1985, is USDZ\*). Specimens with ID-field numbers are being accessioned with this collection.

## SYSTEMATICS

### *Pelophryne murudensis* new species

(Figs. 1–2)

**Material examined.** – Holotype: **ZRC 1.11902** (ex-ID 7833) from Summit Trail to Gunung Murud, ca. 0.3 km from Reked Maligan (Church Camp) (03°54'53.8"N 115°30'11.5"E; 2,120 m a.s.l.) towards Kebun Batu, Sarawak, East Malaysia (northwestern Borneo), collector, I. Das, 4 May.2003.

Paratypes: **ZRC 1.11903–1.11905** (ex-ID 7737; 7839–40); three paratopotypes; other data as for holotype, except collection dates are 4 May.2003, 8 May.2003 and 6 May.2003, respectively. Additional material examined – **SM D.a.3.1.1** (three specimens), Gunung Murud, Sarawak, Malaysia, collected by Eric Georg Mjöberg in 1922. Type locality is indicated in Fig. 5.

**Diagnosis.** – A large (SVL to 25.6 mm in adult males) species of *Pelophryne*, diagnosable from congeneric species in showing the following combination of characters: head wider than long; snout oblique in profile; eye diameter less than snout length; tympanum exposed, over half diameter of eye; forehead lack pustulose tubercles; tubercles on dorsum not spinose and not surrounded by ring of asperities; digits swollen but not dilated; Finger I without a free phalange; webbing on Toe V to tip; subarticular tubercles distinct; mandibular spines and nuptial pads absent; cloacal opening around middle level of thighs; primary colour of dorsum brown, lacking an hour-glass pattern; dark throat spots present but no pale flank stripe and a dark U-shaped mark on venter.

Table 1. Measurements (in mm) of the type series of *Pelophryne murudensis*, new species. See text for details. Abbreviations: SVL = snout-vent length; HL = head length; HW = head width; HD = head depth; BW = body width; TBL = tibia length; ED = eye diameter; UE = upper eyelid width; IN = internarial distance; IO = interorbital distance; E-S = eye to snout distance; E-N = eye to nostril distance and A-G = axilla to groin distance.

	ZRC 1.11906 (ex-ID 7833) holotype	ZRC 1.11907 (ex-ID 7737) paratype	ZRC 1.11908 (ex-ID 7839) paratype	ZRC 1.11906 (ex-ID 7840) paratype	mean	± SE
SVL	21.9	23.6	25.6	22.9	23.5	0.78
HL	5.4	5.4	6.1	5.2	5.53	0.20
HW	6.7	7.0	7.2	6.2	6.78	0.22
HD	4.1	4.1	4.2	4.1	4.13	0.03
BW	7.1	6.8	8.8	8.7	7.85	0.52
TBL	9.7	9.5	9.8	9.3	9.58	0.11
ED	2.3	2.7	2.3	2.3	2.40	0.10
UE	1.5	1.8	2.1	1.8	1.80	0.12
IN	1.6	2.2	2.1	2.2	2.03	0.14
IO	4.8	3.9	4.1	4.6	4.35	0.21
E-S	2.9	2.4	3.0	2.3	2.65	0.18
E-N	2.1	2.0	2.7	2.1	2.23	0.16
A-G	10.3	12.5	14.3	11.6	12.18	0.84

**Description of the holotype (adult male).** – A large species of *Pelophryne*, SVL to 25.6 mm; habitus slender, with a relatively narrow waist (Fig. 1); head much wider than long (HW/HL ratio 1.24), slightly depressed; snout squarish at the tip, when viewed dorsally, extending slightly beyond mandible, and oblique in lateral view; nares narrow-oval, wider horizontally, not elevated, laterally positioned, nearer tip of snout than to orbit of eye (E-N/E-S ratio 0.72); internarial distance less than distance from anterior margin of eye to nostril (IN/E-N ratio 0.76); eyes large (ED/HL ratio 0.43); eye diameter greater than eye to nostril distance (ED/E-N ratio 1.10); upper eyelids small; pineal ocellus not visible externally; interorbital width more than thrice upper eyelid width (IO/UE ratio 3.20); canthus rostralis distinct; loreal region slightly concave; maxillary teeth absent; a weak symphyseal knob on anterior edge of mandible; mouth extending beyond posterior corner of eye; no rictal glands at posterior corner of mouth; weak tubercles on forehead; mandibular spines absent; asperities on gular region



Fig. 1. Holotype of *Pelophryne murudensis*, new species (ZRC 1.11902) in life.

comprises obtuse tubercles; tongue oval, rather elongate, non-papillate, free posteriorly; choanae located close to antero-lateral edge of palate; vomerine ridge absent; vocal sac aperture located near angle of jaws; contracted pupil elliptical; tympanum visible, its annulus indistinct, oval, measuring 1.3 mm in horizontal diameter and 1.7 mm in vertical diameter, smaller than orbit of eye (ED/tympanum ratios 1.77 and 1.35, respectively); distance between eye and tympanum 0.7 mm, or 30.4% diameter of eye and 53.8% horizontal tympanum diameter; supratympanic fold absent; parotoid gland absent; subgular vocal sac, with paired openings; no supracloacal fold; postcloacal tubercles large, distinct; cloacal opening high relative to position of thighs; dorsum of body and limbs with large, rounded tubercles; tubercles largest in postocular region and on anterior portion of flanks; ventral surface of body tuberculate, most marked

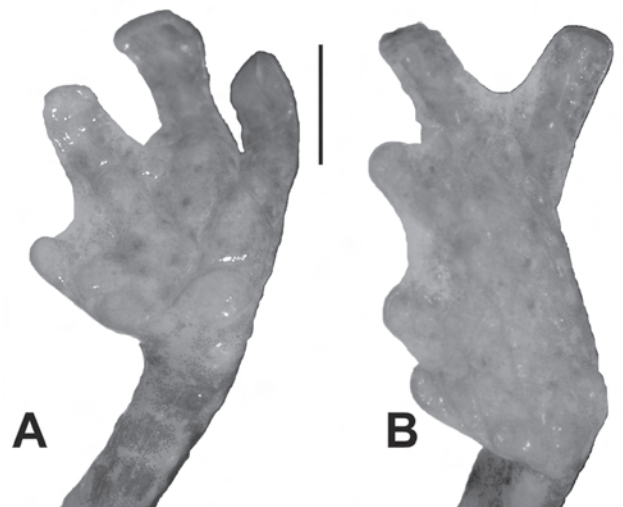


Fig. 2. Left manus (2A) and pes (2B) of holotype of *Pelophryne murudensis*, new species (ZRC 1.11902). Scale bars = 2 mm.

Table 2. Measurements (in mm) of the type series of *Pelophryne linanitensis*, new species. See text for details. Abbreviations: SVL = snout-vent length; HL = head length; HW = head width; HD = head depth; BW = body width; TBL = tibia length; ED = eye diameter; UE = upper eyelid width; IN = internarial distance; IO = interorbital distance; E-S = eye to snout distance; E-N = eye to nostril distance and A-G = axilla to groin distance.

	ZRC 1.11906 (ex-ID 7740) holotype	ZRC 1.11907 (ex-ID 7744) paratype	ZRC 1.11908 (ex-ID 7859) paratype	ZRC 1.11909 (ex-ID 7860) paratype	ZRC 1.11910 (ex-ID 7861) paratype	mean	± SE
SVL	18.6	17.8	18.3	18.0	18.3	18.20	0.14
HL	4.6	4.1	4.8	4.9	4.1	4.50	0.17
HW	5.5	5.4	6.0	6.1	6.0	5.80	0.14
HD	3.3	3.6	3.5	3.1	4.0	3.50	0.15
BW	7.3	5.5	6.3	6.8	7.0	6.58	0.31
TBL	7.1	7.3	7.3	6.6	6.7	7.00	0.15
ED	2.1	2.0	2.4	1.8	2.0	2.06	1.00
UE	1.8	1.4	1.5	1.5	1.7	1.58	0.73
IN	1.5	2.1	1.9	1.7	1.5	1.74	0.12
IO	3.7	3.4	3.7	3.6	3.2	3.52	0.10
E-S	2.4	2.7	2.1	2.1	2.4	2.34	0.11
E-N	1.2	1.4	1.3	1.2	1.2	1.26	0.04
A-G	9.4	7.6	8.4	7.7	7.7	8.16	0.34

in abdominal region, where tubercles are flattened, rounded and in contact with each other.

Arm short and stout; fingers (Fig. 2A) short and stout, with extensive webbing; no free phalange projecting from web of Finger I; relative length of fingers:  $3 > 4 > 2 > 1$ ; tips of finger weakly expanded, not dilated; width of tips of Finger III wider than those on other fingers; manus with fleshy webbing; outer aspect of Finger I, to base of swollen tip; inner and outer aspects of Fingers II–III and inner aspect of Finger IV, broadly to subarticular tubercle; dermal fringe along outer aspect of Finger IV extends to apical region; no nuptial pads or spines on fingers; subarticular tubercles present but indistinct, rounded, subequal on fingers and toes, numbering one on first and second fingers, and two on third and fourth fingers; palmar tubercles present; hind limbs slender and relatively short (TBL/SVL ratio 0.44), failing to meet when folded right angle to axis of body; toes (Fig. 2B) long; webbing on Toes I and II up to tip of disks, with no free phalanges; on toe III, to base of disks; on Toe IV and inner aspect of Toe V, to level of distal subarticular tubercle; on inner aspect of Toe I and outer aspect of Toe V, dermal fringe present to toe tips; relative length of toes:  $4 > 5 > 3 > 2 > 1$ ; toe tips expanded; subarticular tubercles rounded, numbering one on first, second and fourth toes, two on third and fifth toes; oval, inner and outer metatarsal tubercles; heel without a postaxial fold.

**Colour.** – In life, dorsum Fuscus (#21), or greyish-brown; a Dusky Brown (#19), or dark brown angular, interorbital bar in the form of a V-shaped mark, that is fused to a triangular mark of the same colour, narrow anteriorly, at the back of forehead; another dark triangular patch of the same colour at mid-dorsum, with its narrow edge anteriorly, forming a dark-brown hour-glass marking; a Dusky Brown (#19), or dark grey-brown preocular stripe extends from nostrils to

eye, and continuing along postocular region, broadening after the level of tympanum, and continuing along flanks, sharply set off from the relatively lighter dorsum; lower flanks Cream Color (#54), or greyish-cream, with fine, scattered dark pigments; a pale subocular spot present; tympanum Buff (#124), or medium brown; tubercles on dorsum Scarlet (#14) in life, turning greyish-brown in preservative, paler apically; upper surfaces of limbs with Dusky Brown (#19), or dark-banded, with paler narrow intervening areas; throat and rest of venter Buff (#124), with Sepia (#219), or dark grey smudges, especially on throat and lower lips and a large (height 3.7 mm; width 5.8 mm) horse-shoe shaped mark of the same colour on abdominal region that is open posteriorly; pupil black and iris golden.

**Measurements (in mm, holotype followed by the range, mean and SE in paratypes in parentheses).** – SVL 21.9 (21.9–25.6, mean  $23.5 \pm 0.78$ ); HL 5.4 (5.2–6.1, mean  $5.53 \pm 0.20$ ); HW 6.7 (6.2–7.2, mean  $6.67 \pm 0.20$ ); HD 4.1 (4.1–4.2, mean  $4.13 \pm 0.03$ ); BW 7.1 (6.8–8.8, mean  $7.85 \pm 0.52$ ); TBL 9.7 (9.3–9.8, mean  $9.58 \pm 0.11$ ); ED 2.3 (2.3–2.7, mean  $2.40 \pm 0.10$ ); UE 1.5 (1.5–2.1, mean  $1.80 \pm 0.12$ ); IN 1.6 (1.6–2.2, mean  $2.03 \pm 0.14$ ); IO 4.8 (3.9–4.8, mean  $4.35 \pm 0.21$ ); E-S 2.9 (2.3–3.0, mean  $2.65 \pm 0.18$ ); E-N 2.1 (2.0–2.7, mean  $2.23 \pm 0.16$ ) and A-G 10.3 (10.3–14.3, mean  $12.18 \pm 0.84$ ). See also Table 1.

**Etymology.** – Latin for inhabitant of Gunung Murud.

**Ecological notes.** – Only males of this species are known, all collected from montane forests, from edges of forest trails. They were found calling from leaves, 5 cm to 2 m above substrate, between 1900–2200 h. Call is a continuous trill. Species found in sympatry include *Leptobrachium montanum*, *Philautus petersi* and *P. mjobergi*. Females of the species remain unknown. Dominant genera of trees



within the montane vegetation habitat of the new species include *Leptospermum*, *Podocarpus*, *Agathis*, *Dacrydium* and *Dacrycarpus*, characterised by small, thick leaves and stems, reaching up to 20 m. The undergrowth includes the pitcher plants, *Nepenthes murudensis* and *N. muluensis*, and the terrestrial montane ferns *Dipteris conjugata* and *Blechnum vestitum*. The larval stages of the new *Pelophryne* remain unknown, and the species may breed in the pitchers of *Nepenthes*.

**Comparisons.** – In showing finger tips not wider than basal phalanges, *Pelophryne murudensis* differs from *P. brevipes*, *P. guentheri*, *P. rhophophilus* and *P. signata*. Its oblique (vs. vertical) snout differentiates it from *P. albotaeniata*. The lack of a free phalange on Finger I differentiates it from *P. lighti*. Finally, its distinct subarticular tubercles and absence of both mandibular spines and nuptial pads differentiate it from *P. api* and *P. misera*.

Distribution of character states of *Pelophryne* species as recognised at present are in Table 3.

#### *Pelophryne linanitensis*, new species

(Figs. 3–4)

**Material examined.** – Holotype: ZRC 1.11906 (ex-ID 7740) from the summit of Batu Linanit (03°55'54.7"N 115°31'05.7"E; 2,250 m a.s.l.), Gunung Murud, Sarawak, East Malaysia (northwestern Borneo), I. Das coll., 10 May.2003.

Paratypes: ZRC 1.11907–1.11910 (ex-ID 7744; 7859–61); four paratopotypes; other data as for holotype, except all paratypes were collected on 11 May.2003. Type locality is indicated in Figure 5.

**Diagnosis.** – A mid-sized (SVL to 18.6 mm in adult males) species of *Pelophryne*, diagnosable from congeneric species in showing the following combination of characters: head wider than long; snout vertical in profile; eye diameter less than snout length; tympanum exposed, over half diameter of eye; forehead lack pustulose tubercles; tubercles on dorsum not spinose and not surrounded by ring of asperities; digits swollen but not dilated; Finger I without a free phalange; webbing on Toe V to tip; subarticular tubercles distinct; mandibular spines absent; nuptial pads present; cloacal opening at lower level of thighs; primary colour of dorsum brown, with an hour-glass pattern; dark throat spots absent; pale flank stripes present and dark U-shaped mark on venter absent.

**Description of the holotype (adult male).** – A mid-sized species of *Pelophryne*, SVL 18.6 mm; habitus slender, with a relatively narrow waist (Fig. 3); head much wider than long (HW/HL ratio 1.20), slightly depressed; snout squarish at the tip, when viewed dorsally, extending slightly beyond mandible, and vertical in lateral view; nares narrow-oval, wider horizontally, not elevated, laterally positioned, about midway between tip of snout and anterior corner of eye (E-N/E-S ratio 0.50); internarial distance greater than distance from anterior margin of eye to nostril (IN/E-N ratio 1.25); eyes large (ED/HL ratio 0.46); eye diameter greater than

eye to nostril distance (ED/E-N ratio 1.75); upper eyelids small; pineal ocellus not visible externally; interorbital width more than thrice upper eyelid width (IO/UE ratio 3.20); canthus rostralis weakly defined; loreal region slightly concave; maxillary teeth absent; a weak symphyseal knob on anterior edge of mandible; mouth extending beyond posterior corner of eye; no rictal glands at posterior corner of mouth; weak tubercles on forehead, that lack pale tips; mandibular spines absent; asperities on gular region comprises obtuse tubercles; tongue oval, rather elongate, non-papillate, free posteriorly; choanae located close to antero-lateral edge of palate; vomerine ridge absent; vocal sac aperture located near angle of jaws; contracted pupil elliptical; tympanum visible, its annulus indistinct, oval, measuring 1.2 mm in horizontal diameter and 1.4 mm in vertical diameter, smaller than orbit of eye (ED/tympanum ratios 1.75 and 1.50, respectively); distance between eye and tympanum 0.7 mm, or 33.3% diameter of eye and 58.3% horizontal tympanum diameter; supratympanic fold absent; parotoid gland absent; subgular vocal sac, with paired openings; no supraclacal fold; postclacal tubercles large, distinct; cloacal opening low relative to position of thighs; dorsum of body and limbs with low, rounded tubercles; tubercles largest in post-tympanic region and along flanks; ventral surface of body tuberculate, most marked in abdominal region, where tubercles are flattened, rounded and in contact with each other.

Arm short and stout; fingers (Fig. 4A) extremely short and stout, with extensive webbing; no free phalange projecting from web of Finger I; relative length of fingers: 3 > 4 > 2 > 1; tips of finger not expanded; manus with fleshy webbing; Fingers I–II bound by webbing up to their tips to Finger III; on inner and outer aspects of Finger III and on inner aspect of Finger IV, webbing reaches distal subarticular tubercle; no dermal fringe on outer aspect of Finger IV; a pale nuptial pad on Finger I, which is spinose; subarticular tubercles rounded, those on toes larger than the ones on fingers, numbering one on first and fourth fingers, and two on third finger; palmar tubercles present; hind limbs slender and relatively short (TBL/SVL ratio 0.38), failing to meet when folded right angle to axis of body; toes (Fig. 4B) long; webbing covering Toes I–III up to tips, with no free

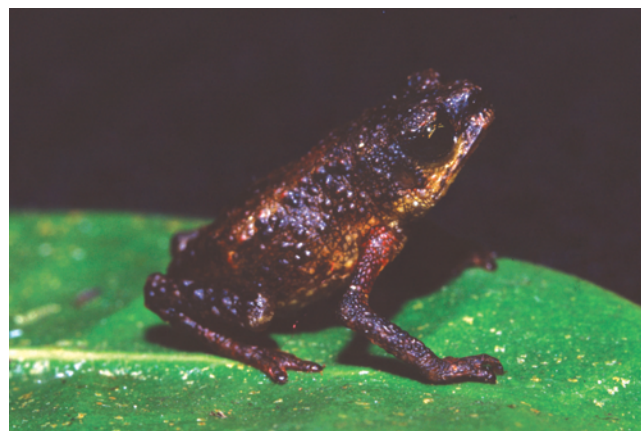


Fig. 3. Holotype of *Pelophryne linanitensis*, new species (ZRC 1.11906) in life.

phalanges, and forming a pad-like structure; Toes IV and V with weakly swollen tips; on both aspects of Toe IV and on inner aspect of Toe V, webbing reaches the base of weakly swollen tips; no dermal fringe present to toe tips; relative length of toes:  $4 > 5 > 3 > 2 > 1$ ; supernumerary subarticular tubercles, rounded; oval, inner and outer metatarsal tubercles; heel without a postaxial fold.

**Colour.** – Forehead and upper surfaces of limbs close to Jet Black (#89), the V-shaped oblique bands from scapular region on dorsum that reaches the level of the inguinal region Chestnut (#32); tubercles on dorsum and flanks with Pearl Gray (#81) on scanned transparencies, but may be more red in life; upper lips Buff-Yellow (#53), with dark smudges; limbs and digits unbanded; upper surfaces of Toes I–III and associated webbing pale; venter Yellow Ochre (#123C), with large Warm Sepia (#221A) areas; pupil black and iris golden.

**Measurements (in mm, holotype followed by the range, mean and SE in paratypes in parentheses).** – SVL 18.6 (17.8–18.6, mean  $18.20 \pm 0.14$ ); HL 4.6 (4.1–4.9, mean  $4.50 \pm 0.17$ ); HW 5.5 (5.4–6.1, mean  $5.80 \pm 0.14$ ); HD 3.3 (3.1–4.0, mean  $3.50 \pm 0.15$ ); BW 7.3 (5.5–7.3, mean  $6.58 \pm 0.31$ ); TBL 7.1 (6.6–7.3, mean  $7.00 \pm 0.15$ ); ED 2.1 (1.8–2.4, mean  $2.06 \pm 1.00$ ); UE 1.8 (1.4–1.8, mean  $1.58 \pm 0.73$ ); IN 1.5 (1.5–2.1, mean  $1.74 \pm 0.12$ ); IO 3.7 (3.2–3.7, mean  $3.52 \pm 0.10$ ); E-S 2.4 (2.1–2.7, mean  $2.34 \pm 0.11$ ); E-N 1.2 (1.2–1.4, mean  $1.26 \pm 0.04$ ) and A-G 9.4 (7.6–9.4, mean  $8.16 \pm 0.34$ ). See also Table 2.

**Etymology.** – Latin for inhabitant of Batu Linanit.

**Ecological notes.** – Only males of this species are known, all collected from rhododendron forests, from the edge of forest trails, on exposed, wind-swept slopes. They were found calling from leaves, 5–15 cm above substrate, between 1900–2200 h. The call is a metallic ‘ping’, repeated 4–5 times. As in *Pelophryne murudensis*, the females of the present species and its larval stages are unknown, although it is also suspected to breed in pitchers of *Nepenthes*, near

where males were found calling. *Leptobrachium montanum* and *Philautus petersi* were found in sympatry with the new species at this site. The dominant tree species at the type locality were *Agathis kinabaluensis*, *Ternstroemia aneura*, *Tristania aneura*, *Dacrydium xanthandrum* and *Eugenia alcinae*. At the collection site, *Nepenthes murudensis* and *N. muluensis* were common.

**Comparisons.** – In showing finger tips not wider than basal phalanges, *Pelophryne linanitensis* differs from *P. brevipes*, *P. guentheri*, *P. rhopophilus* and *P. signata*. Its vertical (vs. oblique) snout differentiates it from *P. api* and *P. murudensis*. The lack of a free phalange on Finger I distinguishes it from *P. lighti* and webbing to the tip of Toe V from *albotaeniata*. Finally, the new species can be separated from *P. misera* in showing distinct subarticular tubercles, lack of mandibular spines, presence of a dark hour-glass pattern on dorsum and presence of pale flank stripes.

See also Table 3 for distribution of character states of *Pelophryne* species.

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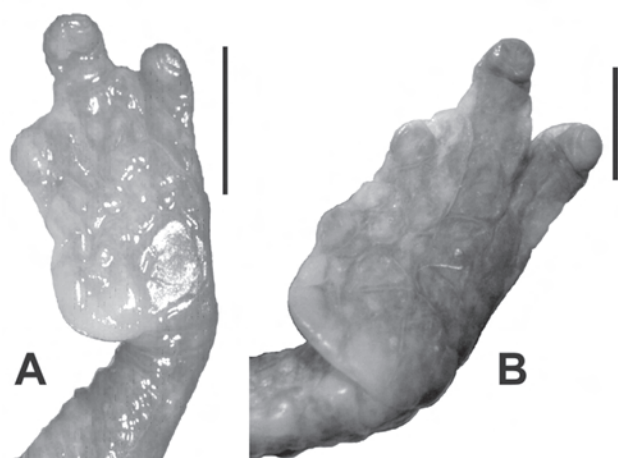


Fig. 4. Left manus (4A) and pes (4B) of holotype of *Pelophryne linanitensis*, new species (ZRC 1.11906). Scale bars= 2 mm.

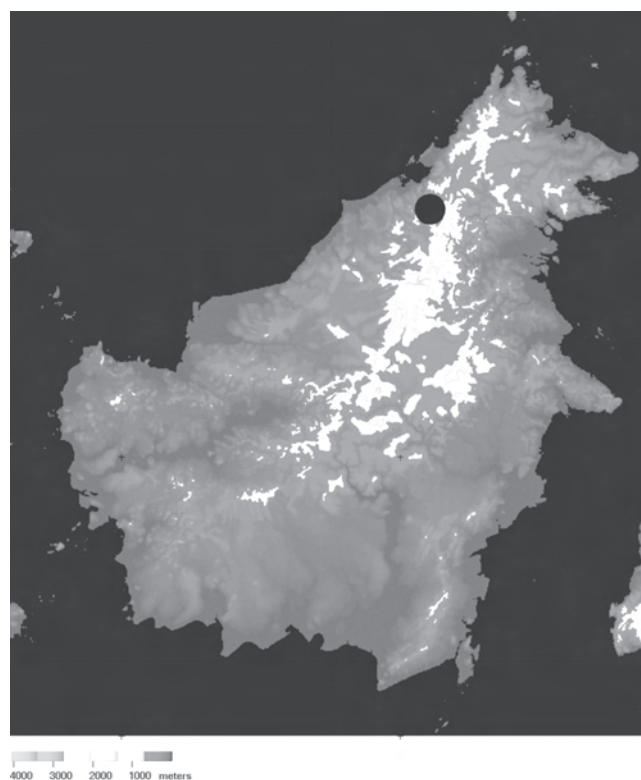


Fig. 5. Map of Borneo, showing the location of Gunung Murud, the general type locality of *Pelophryne murudensis*, new species, and *Pelophryne linanitensis*, new species.

Table 3. Character states and their distribution in species of the genus *Pelophryne*. Abbreviations: + = present; - = absent; +/- = subequal, or present or absent within a taxon.

Character	<i>P. albotaeniata</i> Barbour, 1938	<i>P. api</i> Dring, 1983	<i>P. brevipes</i> (Peters, 1867)	<i>P. guentheri</i> (Boulenger, 1882)	<i>P. lighti</i> (Taylor, 1920)	<i>P. linanitensis</i> , new species	<i>P. misera</i> (Mocquard, 1890)	<i>P. murudensis</i> , new species	<i>P. rhophophilius</i> Inger & Stuebing, 1996	<i>P. signata</i> (Boulenger, 1895)
Maximum male SVL (mm)	19.9	22.3	18.3	29.9	15.0	18.6	22.0	25.6	24.0	23.0
Head wider than long	+/-	+/-	+/-	+	+	+	+	+	+/-	+/-
Snout vertical in profile	+	-	-	-	+	+	+	-	-	-
Eye diameter < snout length	-	+/-	+	-	+	+	+	+	+/-	+/-
Tympanum exposed	+	+	-	+	+	+	+	+	-	+
Tympanum > 1/2 eye diameter	+	-	+	+	-	+	-	+	-	+
Forehead with pustulose tubercles	-	-	-	+	-	-	+	-	+	-
Spinose tubercles on dorsum surrounded by ring of asperities	-	+	-	+	-	-	+	-	+	-
Digits dilated	-	-	+	+	-	-	-	-	+	+
Webbing on Finger I to tip	+	+	+	+	-	+	+	+	-	+
Webbing on Toe V to tip	-	-	-	-	-	+	+	+	+	-
Subarticular tubercles distinct	+	-	-	+	-	+	-	+	-	+
Mandibular spines	+	+	-	+	-	-	+	-	-	-
Nuptial pads	+	-	-	-	-	+	+	-	+	+
Orientation of cloacal opening relative to thigh	Lower	Middle	Middle	Middle	Middle	Lower	Lower	Middle	Middle	Middle
Primary dorsum colouration	Brown	Black	Brown	Brown	Brown	Brown	Black	Brown	Brown	Brown
Hour-glass pattern	-	-	+	+	-	+	-	-	-	+/-
Dark throat spots	-	+	+	+	+	-	+	+	-	+
Pale flank stripe	+	-	+	-	-	+	-	-	-	+/-
Venter with U-shaped pattern	-	-	-	-	-	-	-	+	-	-



My colleagues at the Institute of Biodiversity and Environmental Conservation and the Faculty of Resource Science and Technology, Fatimah Abang, Andrew Alek Tuen, Mustafa Abdul Rahman and Mohammad Tajuddin Abdullah, provided support and friendship during the field work. Information on the flora of the region was provided by Isa bin Ipor, while Arvin C. Diesmos and Tzi Ming Leong provided data on Philippines and Malaysian species, respectively, of *Pelophryne* for Table 3.

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APPENDIX I

**List of comparative material examined**

*Pelophryne api* – ID-8759; ID-8812–8836. Gunung Mulu National Park, Sarawak, Malaysia.

*Pelophryne guentheri* – BMNH 1947.2.19.28. Matang, Sarawak, Malaysia (holotype of *Nectophryne guentheri* Boulenger, 1882); ID-9299. Beyond Frog Pond, Summit Trail, Kubah National Park, Gunung Matang, Sarawak, Malaysia.

*Pelophryne misera* – SP 00387; SP 00358; SP 20615–21; SP 21092–93. Layang Layang, Gunung Kinabalu Park, Sabah, Malaysia; SP 00413. Gunung Kinabalu Park Headquarters, Sabah, Malaysia; SP 00322. Marai Parai, Kemborango, Gunung Kinabalu Park, Sabah, Malaysia; SP 21160–61. Kem. Kopuakom Stesen, Monggis, Gunung Kinabalu Park, Sabah, Malaysia; ID-8053. Summit Trail, Gunung Kinabalu Park, Sabah, Malaysia.

*Pelophryne signata* – ZRC 1.7719. Gua Tangkak Air, near summit of Gunung Kajang, Pulau Tioman, Pahang, Malaysia; ZRC 1.3337. Gunung Kajang, Pulau Tioman, Pahang, Malaysia; ZRC 1.11051. Maxwell's Hill, Perak, Malaysia; ZRC 1.11088 (ex-ID 7589). Gunung Gading National Park, Sarawak, Malaysia, ZRC 1.1686. Gunung Kerong, Rompin, Pahang, Malaysia; ZRC 1.1760. Fern Valley Contour, Bukit Timah, Singapore; BM 68.1993. 3 km N Batang Duri, Temburong District, Brunei Darussalam; UBD 87, 220, 227, 418, 572 and 620. Batu Apoi, Temburong District, Brunei Darussalam; ID-8043–45; SM D.a.3.1.5.b–e. Gunung Penrissen, Sarawak, Malaysia; SBC A.00068 and A.00094. Gunung Tai Tong, Bau, Sarawak, Malaysia; SBC A.00144. Gunung Stulang, Bau, Sarawak, Malaysia; SBC A.00219. Gunung Doya, Bau, Sarawak, Malaysia; SBC A.00262. Gunung Aup, Bau, Sarawak, Malaysia; ID-7554; ID-7564–66. Gunung Beremput, Sarawak, Malaysia; ID-8837–39. UNIMAS East Campus, Kota Samarahan, Sarawak, Malaysia; ID-7916 and 7931, Gunung Santubong, Sarawak, Malaysia; ID-7705, Bako National Park, Sarawak, Malaysia.

In addition, Tzi-Ming Leong kindly examined the following material on my behalf, to complete Table 3:

*Pelophryne albotaeniata* – FMNH 100783 (paratype). Thumb Peak, Palawan, the Philippines; FMNH 51367–72. Mount Balabag, Palawan, Philippines.

*Pelophryne lighti* – FMNH 81588–95. Mount Malindang, Zamboanga Province, the Philippines.