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## Two New Species of Frogs from Borneo

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Two new species of large frogs, one a *Rana* and the other a *Bufo*, were collected by the Borneo Zoological Expedition, 1956, of Chicago Natural History Museum in Sarawak and Sabah (formerly North Borneo).

Abbreviations used in this paper are: BM—British Museum (Natural History); CNHM—Chicago Natural History Museum; NMB—Naturhistorisches Museum Basel; RMNH—Rijksmuseum van Natuurlijke Historie; SM—Sarawak Museum; SNG—Natur-Museum und Forschungs Institut Senckenberg; ZMA—Zoologisch Museum Amsterdam.

I am indebted to the authorities of those institutions for the privilege of studying their material. The field work was sponsored by Chicago Natural History Museum. A study grant from the United States National Science Foundation (G-6257) enabled me to examine types in various European institutions.

The first of these new forms is:

### *Rana ibanorum*<sup>1</sup> new species

*Holotype*.—Chicago Natural History Museum no. 76894. An adult male from a small tributary at the juncture of the Baleh and Putai Rivers (1° 48' N, 113° 45' E), Third Division, Sarawak, collected August 5, 1956, by Robert F. Inger and Gaun Sureng.

*Diagnosis*.—A large *Rana* (adult males to about 105 mm.) of the ranae kuhlianae group of Boulenger (1920); tympanum visible through skin; all toes webbed to disks; inner edge of fourth finger

<sup>1</sup> Named for the Ibans, or Sea Dyaks, in whose country the first specimens were obtained.

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with a free flap of skin; males with enlarged mandibular processes but without vocal sacs and nuptial pads.

*Description of holotype.*—Body stocky; limbs heavy; head slightly longer than broad, with muscular swellings in occipital region (secondary sex character); snout pointed, slightly projecting, rounded in profile, longer than eye; nostril nearer to tip of snout than to eye; canthus distinct, rounded; lores concave, oblique; eye diameter slightly longer than eye-nostril distance; interorbital subequal to width of upper eyelid; tympanum distinct through skin, one-half eye diameter, separated from eye by twice its diameter; vomerine teeth in prominently raised, oblique groups narrowly separated from each other and anteromedian corners of choanae; tongue deeply notched.

Fingers with swollen, round tips lacking circummarginal grooves; first finger longer than second, fourth equal to first; subarticular tubercles prominent, those of two inner fingers and basal ones of two outer fingers oval, distal ones of third and fourth fingers round; a feebly distinct, oval outer palmar tubercle, a stronger inner one; movable flaps of skin along both edges of second and third fingers, and on inner edge of fourth finger; outer edge of fourth finger with a thickened ridge of skin.

Toes with distinctly swollen tips; disks lacking circummarginal and dorsal longitudinal grooves; third and fifth toes subequal; all toes broadly webbed to disks on both sides; excision of membrane between two outer toes reaching distal edge of middle subarticular tubercle of fourth when toes are in contact; broad flaps of skin along outer and inner edges of foot, the inner one continued along tarsus as a thickened ridge; subarticular tubercles prominent, elongate, the length of each being two to three times its width; a similarly shaped inner metatarsal tubercle about one-half length of first toe, no outer metatarsal tubercle.

Skin on all dorsal surfaces a network of radiating, low rugae superimposed on which is a system of short raised ridges and round tubercles; small white asperities on dorsal surfaces, the larger ones on the raised ridges and tubercles and especially numerous on upper eyelid; a strong supratympanic fold from eye to arm insertion, ventral surfaces smooth.

Color (in alcohol) blackish brown above becoming lighter gray on sides; body and top of head with no visible markings; dorsal surfaces of limbs with obscure dark crossbars; hind face of thigh dark



gray with black mottling; lips with narrow light bars; throat whitish with bold dark mottling; rest of ventral surfaces white, immaculate.

*Measurements* (mm.).—Snout-vent 102.8, head length (to rear of commissure) 45.0, head width 40.6, tympanum 5.1, tibia 52.3, foot 51.2.

*Paratypes*.—CNHM 76896–902, 76905–8, 76912–24, 76926, 76929–31, 76933, 76936–65, 76971–89, 78302–3 from the type locality; CNHM 79999 and SM unnumbered (5), headwaters of the Baleh River, Sarawak; SM unnumbered (1), Lupar River Valley, Sarawak; SM unnumbered (1), Akah River, Sarawak; CNHM 109480–1, SM unnumbered (12), Tutoh River, Sarawak; CNHM 128196, 128198–200, Kelabit Plateau, Sarawak, RMNH unnumbered, Long Petah, Kalimantan.

The paratypes agree with the holotype in most respects. This applies even to the smallest ones (11.9–14.6 mm.), in which such characters as the flap of skin on the inner edge of the fourth finger and the distinctive form of the dorsal skin are clearly distinguishable.

Most of the paratypes are lighter than the holotype and are usually a dark gray. A few obscure darker blotches appear on the dorsum and the bars on the limbs are more prominent. In general, the juveniles have a more distinct dorsal pattern than the adults. The gular pigmentation is also variable though the basic pattern of dark spots or mottling on a white background is the rule in all adults and subadults. Some juveniles have a transverse row of dark spots across an otherwise immaculate white throat.

In approximately three-fourths of these frogs the membrane between the two outer toes is excised to a point somewhat distal to the middle subarticular tubercle of the fourth toe when the toes are held together. In the remainder the excision reaches the center of the tubercle.

The snout-vent measurement varies from 11.9 to 102.8 mm. (holotype). Fifty-five of the 98 specimens are smaller than 50 mm., 17 are between 50 and 69 mm., 9 between 70–79 mm., 10 between 80–89 mm., 5 between 90–99 mm., and 2 are longer than 100 mm.

*Comparisons*.—The elongate subarticular tubercles of the feet, the flaps of skin along the fingers, and the peculiar rugosity of the skin distinguish *ibanorum* from all its congeners in the Indo-Malaysian region, including the Philippines. *Rana kuhli*, which is probably closely related to *ibanorum*, also has movable flaps of skin along the edges of the second and third fingers but never on the inner edge of

the fourth, as in *ibanorum*. In addition, *kuhli* is smaller than the latter and has a hidden tympanum. Other relatives of *kuhli*, such as *laticeps*, are much smaller, have less extensive webbing on the feet, and no flaps on the fingers. Though equaling or exceeding *ibanorum* in size, *blythi*, *macrodon*, *modesta*, and related forms in the Philippines have smoother skin, shorter subarticular tubercles, and no flaps on the fourth fingers.

The second species is a very large toad that has been confused in the literature with *Bufo asper*.

### **Bufo juxtasper**<sup>1</sup> new species

*Bufo asper* Boulenger, 1882, Cat. Batr. Sal. Brit. Mus., p. 313 (part); 1892, Proc. Zool. Soc. London, 1892, p. 508 (part); Mocquard, 1890, Nouv. Arch. Mus. Nat. Hist. Nat., (3), 2, p. 158; Smith, 1931, Bull. Raffles Mus., no. 5, p. 30 (not of Gravenhorst).

*Holotype*.—Chicago Natural History Museum no. 77472, an adult female collected on the banks of the Sungei Tawan, Kalabakan, Tawau District, Sabah, on June 5, 1956, by Robert F. Inger and Gaun Sureng.

*Diagnosis*.—A giant species of *Bufo* (adult females growing to more than 200 mm.); thick supratympanic bony crests; parotoid more than twice as long as wide and always much longer than diameter of eye; toes webbed to tips; parietal crests absent.

*Description of holotype*.—Habitus stocky, limbs relatively long; head wider than long, width 0.342 of snout-vent; head with thick supratympanic crest separating parotoid and eyelids; a thick supra-orbital but no parietal crest; snout truncate (slightly flattened in storage), vertical in profile, slightly longer than diameter of eye; nostril at end of snout; canthus rounded; lores vertical, not concave; interorbital wider than upper eyelid; tympanum distinct except for posterior rim, less than one-third diameter of eye.

Fingers moderately long; tips swollen but not wider than other parts of fingers; first finger equals second; subarticular tubercles large, simple; supernumerary metacarpal tubercles present. Tips of toes like those of fingers; third toe slightly longer than fifth, fourth much the longest; all toes except fourth webbed to swollen tips, fourth toe with  $1\frac{1}{2}$  phalanges free; subarticular tubercles conspicuous, round, simple; inner metatarsal tubercle low, oval, about three-fourths length of first toe; outer metatarsal tubercle round, almost as large as inner one; a sharp tarsal ridge; tibia 0.424 of snout-vent.

<sup>1</sup> From *juxtra* (L.), near to + *asper*, a related species.

Skin of back, sides, and legs with large, round warts; skin between large warts with few small tubercles; upper eyelids and sides of head with many small warts; warts of head, trunk, and limbs each tipped with a melanic spinule; a large, conical riatal wart; ventrally coarsely granular, each granule with a melanic tip; parotoid oval, as long as its distance from tip of snout, its width 0.38 of its length.

Color (in alcohol) blackish brown above, yellowish brown below; no markings.

*Measurements* (mm.).—Snout-vent 170; length of tibia 72.2; width of head 68.2; length of parotoid 43.6; width of parotoid 16.5; length of upper eyelid 16.8; diameter of tympanum 5.1.

*Paratypes*.—CNHM 77471, 77473, 77476-7, 77479, 77487-8, from the type locality; CNHM 77463-5, 77467-70, Deramakot, Sabah; CNHM 121310-3, 121321-44, 121346-51, 121536-7, Ranau, Sabah; CNHM 121314-6, Kasiqi, Sabah; CNHM 121317-8, Tuaran, Sabah; CNHM 121319, 121345, Menggatal, Sabah; BM 95.11.7.88 Mount Kina Balu, Sabah; CNHM 71539 Pa Brayong, Sarawak; CNHM 81263, Lupar River valley, Sarawak; CNHM 81264-70, upper Baleh River, Sarawak; CNHM 128132-5, Long Lelang, Sarawak; CNHM 128141-3, Pa Main, Sarawak; SM unnumbered, Tutoh River, Sarawak; BM 64.9.2.33, "Borneo"; RMNH unnumbered, upper Mahakam River, Kalimantan; RMNH unnumbered, upper Sibau River, Kalimantan.

The paratypes range in size from 10.2 (no tail) to 140 mm. Parotoid shape is essentially like that of the holotype in all toads larger than 20 mm.; in none is the width of the parotoid equal to half its length. Parotoid length varies from 0.175 to 0.256 of snout-vent, tibia length from 0.424 to 0.484 (median 0.456; N=12), and head width from 0.335 to 0.379 (median 0.354; N=13). Variation in other body proportions is given in Table 1.

The snout is usually obtusely pointed and slightly projecting in profile. Though none has dorsal markings, many have dark throats (not related to sex) and dark spots on the abdomen. The supra-orbital ridges are not evident in toads smaller than 70 mm.

*Comparisons*.—The thick supratympanic crests, the completely webbed third and fifth toes, the large size, and the absence of parietal crests distinguish *Bufo juxtasper* from all species of *Bufo* in south-eastern Asia and the East Indies except *B. asper*.

*Bufo juxtasper* is very similar to *asper* and has been referred to in the literature (see synonymy) as *asper*. Mocquard (1890) and

Boulenger (1892) were tempted to describe the *asper*-like toads from Borneo having long parotoids as a new species. Boulenger refrained from doing so because he could find “. . . no other ground for such a separation than the size and form of the parotoids, a character which varies so much in certain other species of this genus . . .” (1892, p. 508).

TABLE 1.—COMPARISON OF BODY PROPORTIONS OF BORNEAN SPECIMENS OF *BUFO ASPER* AND *B. JUXTASPER*

Species	Snout-vent <sup>1</sup> (mm.)	Diameter of eye <sup>2</sup>			Tympanum <sup>3</sup>		
		No.	Range	Median	No.	Range	Median
<i>asper</i> . . . . .	72.6–120.8	13	105–146	130	13	309–364	346
<i>juxtasper</i> . . . . .	63.7–138.0	12	110–142	121	12	241–304	270

<sup>1</sup> Of specimens used in obtaining body proportions.

<sup>2</sup> In terms of thousandths of snout-vent.

<sup>3</sup> In terms of thousandths of diameter of eye.

Were this actually the only difference between the two forms, Boulenger's conclusions would carry weight. But the two forms also differ in the size of the tympanum (Table 1), the number of vocal sac openings, the size at which males reach maturity, and the tuberculation of the skin.

The parotoid of *asper* is round, oval, or subtriangular, and its width is at least one-half its length (width/length 0.55–0.79 in 15 from Java; 0.52–1.00 in 22 from Borneo); the length of the parotoid rarely equals the diameter of the eye in the Bornean population. The parotoid of *juxtasper* is more elongate, its width never exceeding one-half its length (width/length 0.30–0.48 in 40 from Borneo); its length is always greater than the diameter of the eye. Differences between these two forms in relative parotoid lengths hold true at all sizes from 20 mm. upward and scarcely overlap.

Differences between the two forms in the ratio of diameter of tympanum to diameter of eye (Table 1) cannot be accounted for by age (as determined by snout-vent lengths) or by differences in eye size. As Table 1 shows, *juxtasper* has a slightly smaller eye than *asper*. If the difference in the tympanum ratio were affected by eye size, the ratio should be larger in *juxtasper* than in *asper*, the reverse of the actual situation.

Differences between adult males of *asper* and *juxtasper* from Borneo in size at maturity and number of vocal sac openings are shown in Table 2. Males from other parts of the range show similar char-

acters. Four adult males of *juxtasper* from Sumatra (SNG 22444-47) have nuptial pads and single vocal sac openings; they measure 110-118 mm. Five males of *asper* from Thailand, Malaya, and Sumatra have nuptial pads and paired vocal sac openings; they measure 88-93 mm. Another male *asper* from Sumatra measuring 67.4 mm. has paired vocal sac openings but no nuptial pads. Adult males of *asper* from Java are slightly larger (94.3-109.4 mm., N-3) but have paired vocal sac openings as do other populations.

TABLE 2.—DIFFERENCES BETWEEN MALES OF *BUFO ASPER* AND *B. JXTASPER* FROM BORNEO IN SIZE AT MATURITY AND NUMBER OF VOCAL SAC OPENINGS

Nuptial pads	Paired		Vocal sac openings		Absent	
	<i>asper</i>	<i>juxt-asper</i>	Single <i>asper</i>	<i>juxt-asper</i>	<i>asper</i>	<i>juxt-asper</i>
Present						
Number . . . . .	14	0	3	6	0	0
Snout-vent. . . . .	69.5-98.2	..	85.0-92.0	110.0-122.0	..	..
Absent						
Number . . . . .	0	0	1	2	0	5
Snout-vent. . . . .	..	..	53.2	85.8-108.2	..	67.1-87.4

Females of *juxtasper* are larger than those of *asper*, at least in Borneo. A female of the former from Mount Dulit (SM, unnumbered) measured 215 mm. Mocquard (1890) recorded one from Kina Balu measuring 195 mm.; the description of the parotoid of this toad leaves no doubt that it is *juxtasper*. Two additional Bornean *juxtasper* (CNHM 77472, 121537) are 170 and 175 mm., snout to vent. The largest Bornean *asper* examined (CNHM 109485) is 120.8 mm. long; a female from Thailand (NMB 5081) measures 141.7 mm. and the largest from Java (ZMA 5199) 135.8 mm. Van Kampen (1923) gave 260 mm. as the maximum size for *asper*. Because he did not distinguish between the two species or give the locality of that huge toad, the record cannot be assigned.

Both forms have many round warts on their backs. Between these larger warts, the skin of *asper* has numerous much smaller warts or tubercles giving the skin a coarsely granular appearance. The skin of *juxtasper*, however, has relatively few small tubercles and, as a result, appears almost smooth between the larger warts.

The final evidence for the differentiation of these forms at the specific level is their sympatric occurrence at several places in Borneo without intergradation. Chicago Natural History Museum has both species from Deramakot and Kalabakan in eastern Sabah, from

Ranau in western Sabah, and from several localities in the Baleh River valley in central Sarawak (Fig. 31); the Rijksmuseum van Natuurlijke Historie, Leiden, has both forms from Sungei Sibau and

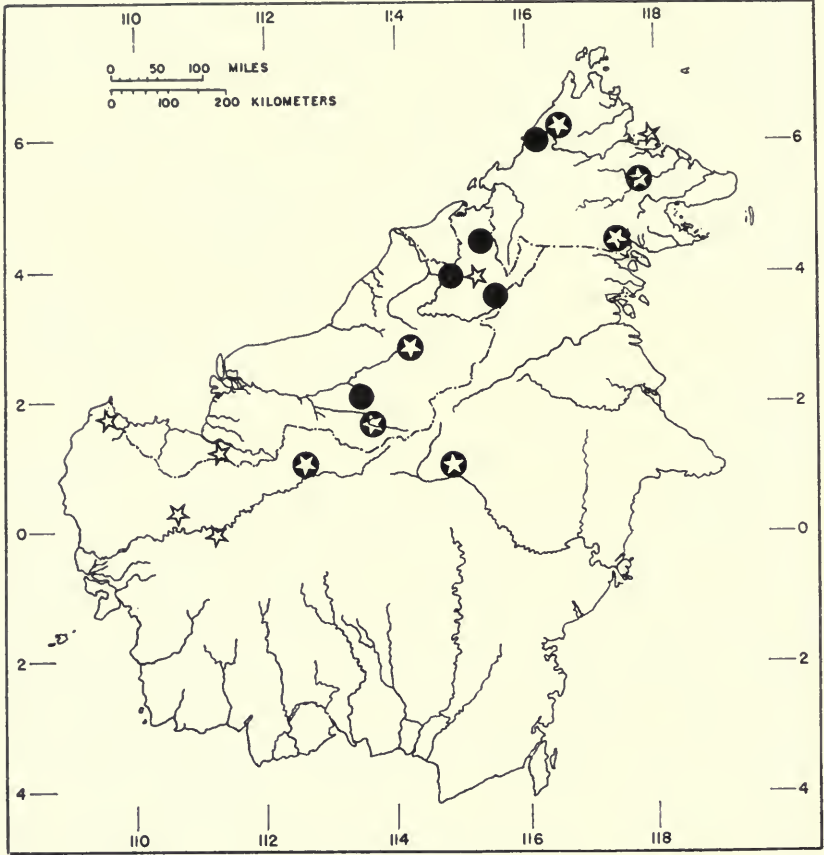


FIG. 31. Map of Borneo showing localities of examined specimens of *Bufo asper* (open stars) and *B. juxtasper* (closed circles).

the upper Mahakam river basin. Both species occur on Mount Dulit, Sarawak (*asper*—BM 92.6.3.21; *juxtasper*—SM unnumbered).

The other Indo-Australian species having thick supratympanic ridges, *Bufo celebensis*, differs from *juxtasper* in its much smaller size (maximum 107 mm., according to van Kampen, 1923), its dermal ossification on the head (especially conspicuous in the temporal region), and its less extensive webbing (toes not webbed to disks).

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