

NEW SPECIES OF RANID FROGS (AMPHIBIA:ANURA) FROM CENTRAL KALIMANTAN, BORNEO

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ABSTRACT. - Two new species of ranid frogs are described from the southern part of Borneo (Central Kalimantan). Both species are characterized by very small clutch size and enlarged ova, indicating departure from the typical ranid reproductive pattern. The new species share characteristics of *Rana kuhlii* and *R. finchi*, and are compared with these and other related species. Further faunal exploration of Kalimantan is expected to uncover additional new species.

INTRODUCTION

Two new species of ranids found recently in Central Kalimantan, Indonesia, have characteristics that resemble those of *Rana kuhlii*, *R. laticeps*, *R. finchi*, *R. hascheana*, etc., that is, species that have been placed in several genera and subgenera by Dubois (1987, 1992). However, because Dubois' classification and taxonomy suffer from a number of weaknesses (Inger, 1996), we do not follow his nomenclature in this paper. Instead, we place the new forms provisionally in the genus *Rana*, knowing that a thorough phylogenetic or cladistic classification ultimately will change their generic assignment.

The known anuran fauna of Borneo continues to expand at a steady rate. The total list of species now stands at 140 and we may expect the number to increase, especially as faunal exploration of Kalimantan proceeds.

Types are deposited in Museum Zoologi Bogor (MZB) and Field Museum of Natural History (FMNH).

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***Rana rhacoda*, new species**

(Fig. 1)

Material examined.—Holotype: an adult female with enlarged ova (MZB 2991) collected at Kalang River, Mentaya Hulu District, East Kotawaringin, Central Kalimantan, Indonesia, (1°25'S/112°20'E), from stream 3 m wide in primary forest, coll. Agustinus Taufik, Jan.1995.

Paratypes: MZB 2992-94, FMNH 252417 from type locality, collected with the holotype.

Diagnosis.—A small species of *Rana*, adult females 21-24 mm SVL, tips of toes swollen, full webbing to distal subarticular tubercle of fourth toe, tympanum partially obscured by skin, an interrupted dorsolateral fold, no inverted V-shaped fold between shoulders, skin between dorsolateral folds with numerous transverse wrinkles.

Description.—Habitus stocky, head not as wide as body in females (males unknown). Snout obtusely pointed, rounded in profile, not projecting; nostril midway between eye and tip of snout, oriented dorsolaterally; canthi distinct, rounded, not constricted; lores sloping, concave; diameter of eye slightly shorter than length of snout; interorbital wider than eyelid; tympanum obscured by skin, only anterior half of rim visible; vomerine teeth in small oblique groups at level of rear of choanae. Fingers with rounded, but not swollen tips; first finger equal to or longer than second; subarticular tubercles distinct; second to fourth fingers with narrow, movable ridges of skin. Toes with distinctly expanded tips, without circummarginal or dorsal grooves; third toe longer than fifth; full webbing to base of swollen tips of first three toes laterally and of fifth toe medially; fourth toe fully webbed to distal subarticular tubercle on both sides; movable flap of skin on outer edge of fifth toe and a narrower one on inner edge of first toe; inner metatarsal tubercle raised, weakly compressed, longer than distance to subarticular tubercle of first toe; no outer metatarsal tubercle; a distinct tarsal ridge proximally from metatarsal tubercle. Heels meeting but not overlapping when legs are flexed. A strong supratympanic fold; a narrow, interrupted dorsolateral fold composed of 8-12 short ridges or elongated tubercles; skin of back with many low, distinct transverse wrinkles; sides anteriorly with oblique ridges, posteriorly with longitudinal ridges or elongated tubercles; chin and throat with weak tubercles; belly with weak transverse wrinkles; hind limb with conical, white-tipped tubercles dorsally on calf, smaller ones on rear of tarsus.

General coloration (in preservative) brown above, white below; top of head medium brown as far as shoulders, side of head brown with irregular lighter areas; a thin light line across rear of interorbital region; area between shoulders and on sides behind axilla black or dark brown; rear half of back light brown without markings; chin and throat white with gray mottling; chest and belly white; ventral surface of thigh white, immaculate or with a few brown spots; ventral surface of calf white with brown spots; rear of thigh dark brown, dark pigment ending in sharp line at posteroventral margin; limbs with dark crossbars dorsally.

Measurements of holotype (mm).—SVL 23.1, head width 8.3, head length 8.2, tibia 10.5, diameter of eye 2.6, length of snout 3.3, eyelid 1.5, interorbital 2.3, metatarsal tubercle 1.5, length of first toe beyond metatarsal tubercle 2.9.

Variation.—The four paratypes are adult females measuring 21.9-23.8 mm. Dorsal coloration and surface of the skin are remarkably uniform in these specimens. All of these frogs, including the holotype, have enlarged ova having a black polar region. One female had 13 enlarged ova in the left ovary measuring 1.8-2.3 mm. Reproduction in this species must surely depart from the typical ranid pattern.

Variation in body proportions of these adults is shown in Table 1. One juvenile (10.0 mm), with black streaks at the end of the body indicating that it had just completed metamorphosis, has the distinctively bicolored back characteristic of *rhacoda*—blackish in the scapular region and light brown in the rear two-thirds.

Etymology.—Specific name from Gr. *rhakodes*, wrinkled, referring to the dorsal skin.

Comparisons.—The lack of males makes it difficult to assign *R. rhacoda* in any of the lineages implicit in the dendrograms of Emerson & Berrigan (1993), who have made the only phylogenetic analysis of this general group of ranids. We will compare it with representatives from each of those lineages. In several characters, *R. rhacoda* differs from all likely related taxa: the anterior-posterior dichotomy of dorsal coloration and the transversely wrinkled skin of the back.

Although considerably smaller (Table 1), the general body form of *R. rhacoda* and its obscured tympanum resemble *R. laticeps* and *R. kuhlii*. However, the coloration and skin of the back differentiate the new species sharply from *R. laticeps* and *R. kuhlii*. Dorsally the last two species have a network of low ridges and, in *R. kuhlii*, many round tubercles tipped with whitish cones on the back. *Rana kuhlii* has more extensive webbing with the fourth toe fully webbed to the base of the swollen tip; *R. laticeps* has less webbing than *R. rhacoda*, with the fourth toe webbed only as far as the middle tubercle. Also, although *R. laticeps* has dermal ridges along the distal phalanges on the second and third fingers, *R. rhacoda* has dermal fringes the full lengths of those fingers.



Fig. 1. *Rana rhacoda*, holotype, actual size 23.1 mm, scale bar = 1cm.

The slightly reduced webbing and body form of *R. rhacoda* recall the Bornean species *R. palavanensis* and *R. finchi*, which constitute another lineage in the dendrograms of Emerson & Berrigan (1993). However, in contrast to *R. rhacoda*, in *R. finchi* and *R. palavanensis* the tympanum is fully exposed, the first toe lacks a dermal fringe medially and the back has an inverted V-shaped scapular fold; *R. rhacoda* also differs from these two species in size and leg length (Table 1).

Rana rhacoda bears some likeness to *R. nitida* Smedley (type locality Tanah Rata, Pahang, Malaysia) in having the fourth toe not fully webbed, the tips of the toes expanded but without grooves, the tympanum partially obscured, and the nostril oriented dorsolaterally. However, *R. rhacoda* is clearly smaller (Table 1) and differs from *R. nitida* in the skin and coloration of the back, in the light interorbital line (*R. nitida* with a dark interorbital bar), in its more extensive webbing (*R. nitida* with fourth toe webbed only as far as middle tubercle and a narrow, rigid dermal margin on the fifth toe), and in the less exposed tympanum (*R. nitida* with only the rear rim of the tympanum hidden).

The smallest of the taxa considered by Emerson & Berrigan (1993) is *R. hascheana*, which has females 25-39 mm (Boulenger, 1920). This species has less extensive webbing (no toes webbed as far as the base of the swollen tips) than *R. rhacoda* and further differs from the new species in having a distinct groove on the dorsal surface of the discs of the toes, non-pigmented ova, a completely exposed tympanum, and in the skin and coloration of the back.

Table 1. Comparison of *Rana rhacoda* with females of other, possibly related species from Borneo and Southeast Asia. P equals significance level (Mann-Whitney U tests) for comparisons with *rhacoda*.

	<i>rhacoda</i>	<i>kuhlii</i>	<i>laticeps</i>	<i>palavanensis</i>	<i>finchi</i>	<i>nitida</i>
Snout-vent length (SVL)						
Range	21.9-23.8	48.9-64.6	32.0-39.5	28.3-39.4	34.1-45.3	34.8-40.6
Mean±SE	22.75±0.34	56.43±1.19	34.86±0.94	31.88±0.47	39.77±0.38	37.61±0.62
N	5	15	7	38	44	10
Tibia/SVL						
Range	0.43-0.46	0.42-0.49	0.48-0.54	0.57-0.64	0.53-0.60	0.49-0.56
Median	0.476	0.461	0.511	0.596	0.557	0.513
N	5	15	6	12	7	10
P			<0.01	<0.01	<0.01	<0.01
Head width/SVL						
Range	0.35-0.37	0.35-0.42	0.35-0.40	0.39-0.41	0.36-0.39	0.37-0.44
Median	0.362	0.384	0.381	0.392	0.377	0.385
N	4	15	6	6	7	10
P		<0.05	<0.05	<0.01		<0.01

Rana asperata, new species

(Fig. 2)

Material examined.—Holotype: MZB 3117, an adult female with enlarged ova, collected at Kalang River, Mentaya Hulu District, East Kotawaringin, Central Kalimantan, Indonesia (1°25'N/112°20'E), coll. Agustinus Taufik & Ezwar Roezzaman, Jan.1995.

Paratypes: MZB 3118-19, FMNH 252416, two adult males, a subadult female, and a juvenile, collected with the holotype.

Diagnosis.—A small species of the *R. kuhlianae* group of Boulenger (1920); adult female 36 mm SVL, adult males 34-38 mm, tips of toes swollen into small discs lacking circummarginal or dorsal grooves, full webbing to distal subarticular tubercle of fourth toe, tympanum visible except for rear third, dorsal skin extremely rough with round tubercles and short ridges capped with whitish cones but no radiating network of low ridges.

Description.—Habitus stocky; head as wide as body, wider in males. Snout broadly rounded, rounded in profile, not projecting; nostril in raised prominence near tip of snout, oriented laterally; canthi distinct, angular, not constricted; lores strongly sloping, concave; diameter of eye slightly shorter than snout; interorbital wider than eyelid; tympanum visible, upper posterior third obscured by skin, about half to three-fifths diameter of eye; vomerine teeth in long oblique rows between and behind choanae. Fingers with rounded, not expanded tips; first finger longer than second; subarticular tubercles distinct; second and third fingers with narrow, movable ridge on both sides. Tips of toes expanded into small round discs without circummarginal or dorsal grooves; third toe longer than fifth; full webbing to base of discs on lateral margins of first three toes and on medial margin of fifth toe, to distal subarticular tubercle of fourth toe; outer edge of fifth and inner edge of first toe with narrow flaps of skin; subarticular tubercles conspicuous; oval inner metatarsal tubercle long, more than half length of first toe; no outer metatarsal subercle; long tarsal ridge from metatarsal tubercle almost to tibiotarsal joint.

All dorsal and lateral surfaces including head very rough, with round tubercles and short ridges of various sizes; longest ridges less than diameter of eye; largest tubercles and ridges capped with whitish cones; no radiating network of low ridges or folds; eyelid covered with conical tubercles; all ventral surfaces smooth; a straight, oblique supratympanic fold.

Color in preservative sandy brown dorsally and laterally, with obscure darker markings; faint, slender light and dark interorbital bars; an oblique light area from rear of eye over tympanum to rear of jaw; obscure labial bars; lower eyelid whitish with small dark dots in clumps; venter whitish, chin and throat with small brown spots, belly with few small brown spots; underside of thigh and calf with small brown spots.

Measurements of holotype : SVL 36.0 mm, T 18.5, HW 16.6, HL 15.0, eye 4.8.

The left ovary of the holotype had nine enlarged yolked ova (1.8-3.5 mm) having a large black area near the pole. Five pale cream ova measured 1.0-1.3 mm; the remaining ova (<1.0 mm) were whitish and appeared to lack any yolk.

Variation.—The male paratypes measure 34.9 and 38.8 mm SVL, the subadult female 29.5, and the juvenile 20.1. T/SVL (holotype, subadult, males) 0.54, 0.54, 0.48-0.49; HW/SVL 0.45, 0.48, 0.46-0.49; HL/SVL 0.43, 0.42, 0.40-0.44. The males have conspicuously enlarged “fangs” at the tip of the lower jaw. In the two males, the length of the fang (measured from its tip to the ventral edge of the lower jaw) is 0.07 of SVL; in the two females, the ratio is 0.04. Males lack vocal sacs and nuptial pads.

Raised knobs are present at the rear of the frontoparietals (two males examined).

Etymology.—Species name from Latin *asper*, rough, referring to the nature of the dorsal skin.

Comparisons.—The absence of vocal sacs and nuptial pads and the presence of frontoparietal knobs and swollen tips of the toes ally *R. asperata* with the lineages including *R. blythi* and *R. kuhlii* in the dendrograms of Emerson & Berrigan (1993). In its habitus, rough skin, small SVL, reduced clutch size and large ova, *R. asperata* resembles *R. laticeps*. Snout-vent length in 12 females of *R. laticeps* having enlarged ova was 31.5–39.6 (mean 34.9). Clutch size in nine Bornean *R. laticeps* varied from 20 to 45 and ovum size in the three females (SVL 33.4–39.6 mm) with the largest ova varied from 2.4 to 2.8 mm. However, *R. asperata* differs from *R. laticeps* in its much rougher skin with raised tubercles but no radiating network of low ridges as in *R. laticeps*, more extensive webbing (fourth toe of *R. laticeps* not webbed beyond middle subarticular tubercle), and a partially exposed tympanum. The reduced clutch size and large ova suggest that *R. laticeps* and *R. asperata* have modified reproductive habits.

The new species also resembles *R. kuhlii* in habitus and rough skin, but *R. asperata* has a much more tubercular skin and lacks the radiating network of low ridges typical of *R. kuhlii*. Other characters of *R. asperata* distinguishing it from *R. kuhlii* include the partially exposed tympanum (never exposed in *R. kuhlii*), the fourth toe webbed only as far as the distal subarticular tubercle (to base of expanded tip of toe in *R. kuhlii*), and smaller size (adult *R. kuhlii* >50 mm).



Fig. 2. *Rana asperata*, holotype, actual size 36.0 mm, scale bar= 5mm

Rana asperata resembles *R. palavanensis* and *R. finchi* in its large ova and small clutch size, but differs from those two species in its much rougher skin, more extensive webbing, hidden rear margin of the tympanum, and shorter leg. *Rana rhacoda*, from the same locality, differs from *R. asperata* in the type of skin rugosity and is much smaller (females <30 mm).

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