

## A NEW SPECIES OF RANID FROG FROM THAILAND, WITH COMMENTS ON *RANA LIVIDA* (BLYTH)

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### ABSTRACT

A New species of *Rana*, superficially resembling *Rana livida*, has been found in northern Thailand. The new species is like *R. livida* in having grooves around the discs of the fingers and green color dorsally, and in lacking humeral glands. It is smaller than *R. livida* and further differs from the latter in having an outer metatarsal tubercle and in lacking sexual dimorphism in the size of the tympanum. It is compared with other species from Southeast Asia that share expanded finger tips, green dorsal coloration, and other characters.

### INTRODUCTION

Serious study of the amphibians of Thailand began with the excursions in the country of Malcolm A. Smith, who published a series of papers beginning in 1915. Much later E. H. Taylor collected widely in Thailand and published a monographic study (TAYLOR, 1962) of the amphibians. Despite this attention, this part of the fauna of Thailand is still imperfectly known. We report here on a new species of ranid frog, a species that has been found twice but has remained hidden in collections under the name *Rana livida*.

### MATERIALS AND METHODS

Measurements were made with a dial calipers to the nearest 0.1 mm. Abbreviations used are: SVL snout-vent length, T tibia length, HW head width at tympanum, HL head length from rear of mandible to tip of snout, TY horizontal diameter of tympanum, DF3 width of disc of third finger. We have examined specimens in the collections of The Natural History Museum, London (BMNH), Field Museum of Natural History (FMNH), and Royal Forest Department, Thailand (RFD).

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***Rana archotaphus*, new species**

**Holotype** FMNH 214074, adult male, collected at Dawn Tak Them, Doi Inthanon National Park, Chiang Mai Province, Thailand at 1100 m, by Doyle Damman, on 10 August 1979.

**Paratypes** FMNH 214072–73, 214075–76, collected with the holotype; 216072–74. FMNH 187447–48, 216074 from Doi Inthanon National Park at 1500 m. FMNH 216072–73 from Doi Inthanon National Park at 1100 m.

**Diagnosis.**—A medium-sized species of *Rana* having three outer fingers expanded into round discs with circummarginal grooves, first finger shorter than second, distinct round outer metatarsal tubercle, weak or no dorsolateral fold, males with gular pouches but no humeral glands.

**Etymology.**—Species name from *archon* (Gr), meaning ruler, and *taphus* (Gr), meaning grave. Doi Inthanon is the mountain where the ashes of a former King of Chiang Mai were buried.

**Description.**—Habitus moderately slender; head narrow; snout obtusely pointed, slightly projecting, round in profile, not depressed; nostril lateral, posterior to tip of lower jaw, slightly closer to tip of snout than to eye; canthus angular, not constricted; lores concave, weakly sloping; eye diameter equal to or longer than snout; interorbital wider than eyelid; tympanum superficial, about two-thirds diameter of eye; vomerine teeth in small oblique groups near midline of palate.

Tips of three outer fingers expanded, about twice width of phalanges, with circummarginal grooves, disc of third finger equal to or wider than tympanum; tip of first finger not expanded, without groove; first finger shorter than second; subarticular tubercles prominent; weak supernumerary tubercles on outer fingers; third finger with or without weak dermal ridge medially.

Tips of toes expanded, slightly narrower than discs of outer fingers; fifth toe longer than third; first three toes laterally and fifth toe medially fully webbed to base of discs; fourth toe fully webbed to distal subarticular tubercle or not quite so far; subarticular tubercles prominent; an oval inner and a small, round outer metatarsal tubercle.

Skin smooth or finely granular dorsally; a weak dorsolateral fold present or not evident; sides and ventral surfaces smooth except under thighs, which are coarsely granular.

Dorsal and lateral surfaces olive green in life, with irregularly distributed small brown spots; dark brown band on side of head with a sharp boundary where it meets the lighter dorsal color, band continuing beyond tympanum, narrowing behind axilla to form a narrow, dark, ventral border to the dorsolateral line; on side of snout, band fading to lighter brown bordered by white streak along upper lip to axilla, margin of lip (in preservative) brownish; venter ivory, with or without pale brown spots; limbs with dark brown crossbars.

Measurements (mm) of holotype: SVL 42.1, T 26.4, HW 15.0, HL 14.1, (TY) 2.2, snout depth at nostril (SND) 3.5, snout length (SNL) 5.83.

**Variation.**—One male lacks vomerine teeth and one female has indistinct outer metatarsal tubercles. Variation in size and body proportions is given in Table 1.

Table 1. Variation in size and body proportions in *Rana archotaphus*.

	Males	Females
		SVL <sup>1</sup>
Range (mm)	38.2–42.1	58.8–62.5
Mean±SE	39.96±0.48	
N	8	2
		T/SVL
Range	0.61–0.70	0.65–0.66
Median	0.637	
N	8	2
		HW/SVL
Range	0.31–0.37	0.32–0.34
Median	0.343	
N	8	2
		HL/SVL
Range	0.36–0.39	0.32–0.36
Median	0.367	
N	8	2
		TY/SVL
Range	0.052–0.069	0.052–0.053
Median	0.060	
N	8	2

<sup>1</sup> Abbreviations given in text.

Males have gular pouches at the corners of the jaw and vocal sac openings at the rear of the mouth. The nuptial pad is a cream-colored, velvety structure covering the medial surface of the first finger from its base to the base of the last phalanx, and on the dorsal surface from the base of the finger to the level of the subarticular tubercle. Males have no colorless spinules on the throat or belly, and no asperities on the head or trunk laterally.

Both female paratypes have enlarged non-pigmented ova. Mean ovum diameters (measuring 10 largest ova on surface of ovarian mass) are 2.28±0.05 and 2.21±0.04 mm in the two females.

**Comparisons.**—Of the Southeast Asian species of *Rana*, only four share presence of grooves around the expanded discs of the three outer fingers, the first finger shorter than the second, green dorsal coloration, and male without a humeral gland: *R. archotaphus*, *R. chalconota*, *R. hosii*, and *R. livida*. *Rana archotaphus* differs from *R. chalconota* in having gular pouches (absent in *chalconota*), indistinct dorsolateral fold (sharply defined in *chalconota*), and absence of clear sexual dimorphism in tympanum diameter (male of *chalconota* with conspicuously enlarged tympanum). *Rana archotaphus* differs from both

*R. hosii* and *R. livida* in having an outer metatarsal tubercle (lacking in the others), in having full webbing of the fourth toe ending at the distal subarticular tubercle (to base of disc in the other two), in lacking clear sexual dimorphism in tympanum diameter (males of *hosii* and *livida* with conspicuously enlarged tympanum), and in having smaller females (58–63 versus greater than 80 mm in the other two species).

A number of other species of *Rana* agree with *R. archotaphus* in having gular pouches: *montivaga*, *humeralis*, *miopus*, *oatesi*, *leptoglossa*, and *guentheri*. *R. archotaphus* differs from all these species in having the first finger shorter than the second and from all except *R. montivaga* in the absence of a humeral gland in males. *Rana montivaga*, *R. humeralis*, *R. miopus*, and *R. oatesi* further differ from *R. archotaphus* in lacking an outer metatarsal tubercle.

### ***Rana livida* (Blyth)**

*Polypedates lividus* Blyth, 1856: 718—Tenasserim, Burma.

*Rana livida* Boulenger, 1887: 484.

Our samples from Doi Inthanon included, besides the types of *Rana archotaphus*, frogs we tentatively identified as *R. livida*. These frogs (FMNH 187449–50, 214071) were smaller than other *R. livida* from Thailand available to us and prompted us to examine specimens from other parts of the species range. One of our samples is from Huai Kha Khaeng in western Thailand, near the type locality of *R. livida*, Tenasserim, Burma. We have also examined material from Khao Yai National Park in eastern Thailand, Loei Province in northern Thailand, Buon Luoi in central Vietnam, Tam Dao in northern Vietnam, Hong Kong, and Sichuan, China.

BOULENGER (1920) distinguished *R. livida* from *R. graminea* BOULENGER (1899) on the basis of "...glandular dorsolateral fold more or less distinct..." (*graminea*) and "...glandular fold absent..." (*livida*). SMITH (1930) placed *R. graminea* in the synonymy of *livida* without comment. BOURRET (1942) suggested that geographic variation in development of dorsolateral glandular folds divided this species into "northern" (= *graminea*) and "southern" populations. That division cannot be supported because the dorsolateral fold varies in expression within samples in a way indicating that the variation is an artifact of preservation.

Although *Rana livida* is usually described as a green frog, some individuals are brown. The sides may be a paler green or a lighter brown than the back, and frogs with a green dorsum may have green or brown lateral coloration. We have seen two photographs of green, brown-sided males in amplexus with brown females, one pair from Khao Yai National Park, Thailand, and one from central Vietnam (photographs by Doyle Damman and Nikolai Orlov). There does not seem to be a geographic pattern to variation in color.

However, there is clear geographic variation in other characters. The most conspicuous difference is in size (Table 2). In pairwise comparisons, males from Khao Yai and Loei, Thailand, are much larger than all the others ( $t > 6.9$ ,  $p < .001$ ), and males from Huai Kha Khaeng, Thailand, are larger than those from Buon Luoi, central Vietnam, and Sichuan, China ( $t > 2.5$ ,  $p < .02$ ). Females from Tam Dao, northern Vietnam, are slightly but significantly larger ( $t = 3.91$ ,  $p < .001$ ) than those from Khao Yai Park and Loei, and much

Table 2. Geographic variation in size and body proportions of *Rana livida*. Abbreviations given in text.

Locality	N	SVL (mm)		T/SVL	HW/SVL	HL/SVL	TY/SVL	DF3/SVL
		Range	Mean±SE					
<b>Males:</b>								
<b>Thailand</b>								
Huai Kha Khaeng	8	49.7–53.8	51.08±1.17	0.61–0.65	0.29–0.34	0.35–0.39	0.084–0.094	0.046–0.057
Khao Yai	9	54.6–70.0	61.49±1.22	0.60–0.66	0.32–0.36	0.37–0.42	0.072–0.083	0.046–0.058
Loei	3	66.5–68.2		0.62–0.66	0.33–0.34	0.36–0.38	0.076–0.085	0.044–0.050
Doi Inthanon	3	42.4–45.4		0.57–0.64	0.31–0.32	0.34–0.38	0.085–0.090	0.043–0.049
<b>Vietnam</b>								
Buon Loui	18	41.5–54.7	46.42±0.73	0.57–0.64	0.31–0.37	0.37–0.44	0.076–0.103	0.041–0.053
Tam Dao	1	49.9		0.61	0.34	0.39	0.095	0.053
<b>China</b>								
Sichuan	10	44.1–48.3	46.08±0.45	0.61–0.65	0.32–0.34	0.38–0.45	0.083–0.108	0.043–0.050
Hong Kong	2	41.5–43.6		0.60–0.65	0.32–0.33	0.39	0.084–0.099	
<b>Females:</b>								
<b>Thailand</b>								
Huai Kha Khaeng	3	94.7–97.2		0.60–0.63	0.32–0.34	0.35–0.37	0.053–0.056	0.040–0.045
Khao Yai	9	94.3–101.5	97.48±0.81	0.61–0.68	0.33–0.35	0.36–0.39	0.055–0.061	0.044–0.053
Loei	2	95.6–105.6		0.60–0.67	0.33–0.34	0.35–0.37	0.052–0.055	0.040–0.053
<b>Vietnam</b>								
Buon Luoi	17	74.0–99.9	86.49±1.81	0.58–0.70	0.31–0.35	0.34–0.40	0.050–0.070	0.039–0.047
Tam Dao	11	95.5–104.4	100.70±0.90	0.56–0.62	0.31–0.35	0.33–0.37	0.050–0.058	0.040–0.048
<b>China</b>								
Hong Kong	2	89.2–93.7		0.58–0.60	0.31–0.32		0.059–0.063	
<b>Burma</b>								
The Triangle	2	87.7–97.4		0.64–0.65	0.33	0.36–0.37	0.051–0.063	
Analysis of variation <sup>1</sup>								
Males								
H <sup>1</sup>		34.11		6.13	7.62	23.29	29.65	22.93
p		<.001		>.20	>.10	<.001	<.001	<.001
Females								
H <sup>1</sup>		22.21		17.03	8.07	18.17	8.54	12.25
p		<.001		<.001	<.05	<.001	<.05	<.01

<sup>1</sup> Kruskal-Wallis analysis of variation.

larger than those from central Vietnam ( $t=5.62$ ,  $p<.001$ ); females from Khao Yai and Loei are significantly larger ( $t=3.81$ ,  $p<.001$ ) than those from central Vietnam.

Covariance tests (using SYSTAT) were carried out on regressions of T, HW, HL, TY and DF3 on SVL. In no case was there a significant difference among samples in slopes ( $p=0.12-0.62$ ). However, as shown in Table 2, there were significant differences among samples in the relative sizes of those body dimensions. In pairwise comparisons (Mann-Whitney U tests), males from central Vietnam and Sichuan had longer heads (HL/SVL) than those from the Thailand localities ( $p<.01$ ), though there was no difference between the Thailand samples ( $P>.10$ ). Males from Khao Yai and Loei had smaller tympana (TY/SVL) than those from any other locality ( $p<.001$ ) and those from Sichuan had larger tympana ( $p<.01$ ) than those from central Vietnam and Huai Kha Khaeng, which did not differ in this ratio. In pairwise comparisons of the DF3/SVL ratio, males of the central Vietnam and Sichuan samples had smaller discs ( $p<.02$ ) than those from Khao Yai and Huai Kha Khaeng. Among females, those from Tam Dao, northern Vietnam, had shorter legs (T/SVL) and shorter heads (HL/SVL) than those from central Vietnam, Khao Yai, and Huai Kha Khaeng ( $p<.10$ , pairwise Mann-Whitney tests). The last three samples did not differ from one another in pairwise tests.

The large males from Khao Yai and Loei have distinct colorless spinules under the chin, throat, chest, and upper lip. The absence of these structures from the other, smaller males may be size related—the smaller ones not having achieved the extreme condition. However, the smaller males have achieved a more extreme condition of tympanic enlargement.

Despite the differences among these samples, there is no clear pattern of local differentiation that would permit recognition of geographic subspecies or sibling species. We recommend no change from current taxonomy, recognizing *Rana livida* as a widespread, moderately variable species and retaining *R. graminea* Boulenger in its synonymy.

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