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A New *Ansonia* from the Isthmus of Kra, Thailand (Amphibia, Anura, Bufonidae)

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ABSTRACT—A new species of torrent-dwelling bufonid frog of the genus *Ansonia* is described from the Isthmus of Kra, Thailand. *Ansonia kraensis* is morphologically similar to Malaysian *A. malayana*, but differs from it in ventral coloration and larval morphology. Occurrence of *A. kraensis* in this region suggests a heterogeneous nature of the anuran fauna between northern and southern regions of the Malay Peninsula.

Key words: *Ansonia* new species, *Ansonia malayana*, Zoogeography, Thailand, Malay Peninsula

INTRODUCTION

The genus *Ansonia* consists of small toads from Southeast and South Asia (Frost, 2004). Members of this genus are characterized by unique larvae that are adapted to life in torrential streams (Inger, 1960). Of the 23 species hitherto known (Frost, 2004), three have been recorded from Thailand (Matsui *et al*., 1998).

During our survey of southwestern Thailand in 1997, we collected two females of an *Ansonia*. The specimens were distinctly different from two Thai congeners (*A. siamensis* Kiew, 1985; *A. inthanon* Matsui, Nabhitabhata, and Panha, 1998), but resembled a third species, *A. malayana* Inger, 1960, originally recorded from Malaysia and listed in the Thai fauna (Matsui *et al*., 1998). However, they were easily distinguished from *A. malayana* by distinct ventral coloration. Subsequent collections of additional metamorphs and larvae to 2004 further strengthened their distinction. In this article, these specimens are described as a new species.

MATERIALS AND METHODS

Fieldwork was conducted at Raksawarn Public Park, Ranong Spa and Punyaban waterfall, both in Ranong Province, Isthmus of Kra, Thailand, on 21 January 1997 and from 22–26 August 1997, 31 December 2001–1 January 2002, and 4–5 December 2004. Metamorphic specimens were fixed in 10% formalin and later preserved in 70% ethanol, or were placed directly in 99% ethanol. Larvae were fixed and preserved in 5% formalin. Assignment of larvae to the new species was based upon the occurrence of adults of that species where the larvae were collected.

We took the following 18 measurements for adult specimens (Table 1) to the nearest 0.1 mm with dial calipers under a binocular dissecting microscope: snout-vent length (SVL); head length (HL), from tip of snout to hind border of the angle of jaw (not measured parallel with the median line); snout length (SL); eye length (EL); tympanum-eye distance (T-EL); tympanum diameter (TD); head width (HW); internarial distance (IND); interorbital distance (IOD); upper eyelid width (UEW); forelimb length (FLL); first finger length (1FL), distance from distal end of inner metacarpal tubercle to tip of first finger; third finger disk diameter (3FDW); hindlimb length (HLL); tibia length (TL); foot length (FL) from proximal end of inner metatarsal tubercle to tip of fourth toe; first toe length (1TL) from distal end of inner metatarsal tubercle to tip of first toe; inner metatarsal tubercle length (IMTL). Measurements were made mainly following Matsui (1984), and the system of description of toe-webbing states followed that used by Savage (1975).

For larvae, the following 14 measurements were taken to the nearest 0.01 mm using a binocular dissecting microscope equipped with a micrometer: total length (TL); head-body length (HBL); maximum head-body width; body depth; eyeball diameter; internarial distance; interorbital distance; oral disk width; upper jaw sheath length; upper sheath's gap width; lower jaw sheath length; snout-spiracle length; tail length; maximum tail depth. Measurements were made mainly following Inger (1985), and staging followed Gosner's (1960) table. For oral apparatus terminology, we followed Altig and McDiarmid (1999).

For diagnosing the new species, we examined 11 specimens of topotypic *A. malayana* from Larut Hills, Perak, Malaysia (KUHE = Graduate School of Human and Environmental Studies, Kyoto University 15435–36, 15466–67, 15469–71, 15475–77, 15515), five specimens of topotypic *A. siamensis* from Khao Chong, Trang, Thailand (KUHE 23438–39, 23514–16), four syntype specimens of *A. inthanon* from Doi Inthanon, Chang Mai, Thailand (KUHE 19031–

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Table 1. Measurements of 18 characters in *Ansonia kraensis*. SVL ($\bar{X}$±SD, in mm) and medians of ratios (R) of other characters to SVL, followed by ranges in parenthesis. See text for character abbreviations.

	SVL*	RHL*	RSL	REL	RT-EL	RTD
Males (N=7)	21.3±1.0	33.2	13.6	10.2	1.6	6.1
	(19.9–22.3)	(30.5–33.5)	(12.3–14.0)	(9.2–10.8)	(1.4–1.9)	(4.4–6.4)
Females (N=8)	25.3±1.4	30.1	12.6	9.6	1.5	5.8
	(24.0–27.9)	(28.8–31.4)	(11.3–13.6)	(8.3–10.8)	(1.1–2.0)	(4.2–7.3)

	RHW*	RIND	RIOD*	RUEW	RFLL*	R1FL*
Males (N=7)	29.7	10.7	12.5	7.6	71.8	5.5
	(28.3–32.2)	(8.3–11.4)	(11.8–13.4)	(7.4–8.3)	(67.3–74.1)	(5.1–5.8)
Females (N=8)	28.3	9.4	10.5	7.6	75.4	6.1
	(27.6–28.9)	(8.1–10.0)	(9.9–13.6)	(6.7–9.1)	(71.7–77.9)	(5.1–6.5)

	R3FDW*	RHLL	RTL	RFL	R1TL	RITML
Males (N=7)	2.6	156.4	50.0	40.8	6.6	5.0
	(2.5–2.8)	(150.7–164.8)	(45.7–51.8)	(38.4–42.5)	(5.8–8.1)	(3.4–6.3)
Females (N=8)	2.4	156.2	47.6	41.0	7.0	4.7
	(2.1–2.6)	(148.7–165.9)	(45.5–53.3)	(38.6–41.8)	(6.6–7.4)	(3.9–5.4)

*: Sexual difference at $p<0.05$.

19032, 19052, 19070), and eight syntype specimens of *A. ornata* Günther, 1876 from Coorg, Mysore, India (BM = Natural History Museum, London. 1944.2.20.65–66, 68–73 [now 74.4.29.944–945, 947–952]).

SYSTEMATICS

Ansonia kraensis **sp. nov.**

(Fig. 1)

Ansonia malayana: Grossmann and Tillack, 2001, p. 21.

Diagnosis

Size small, females from 24.0–27.9 mm, males from 19.9–22.3 mm in SVL; body not much flattened; tympanum visible externally; finger tips only slightly swollen; first finger not reaching disk of second when fingers are adpressed; no longitudinal ridges in interorbital region; third and fifth toes nearly fully webbed; tarsal ridge absent; tibiotarsal articulation of adpressed limb reaching anterior corner of eye; no oblique flap of skin on each side of vent; dorsum without distinct light markings except for a light interscapular spot; venter silvery white mottled with dark brown.

Holotype

KUHE 35053, an adult male from Punyaban waterfall (98°52' E, 10°06' N, 113 m a.s.l.), Ranong Province, Thailand. Collected on 31 December 2001 by W. Khonsue.

Paratypes

KUHE 23517–23518, two adult females, from the same locality as the holotype, collected 21 January 1997 by M. Matsui; KUHE 35054, an adult male and KUHE 35055, young, same data as the holotype, by W. Khonsue and T.

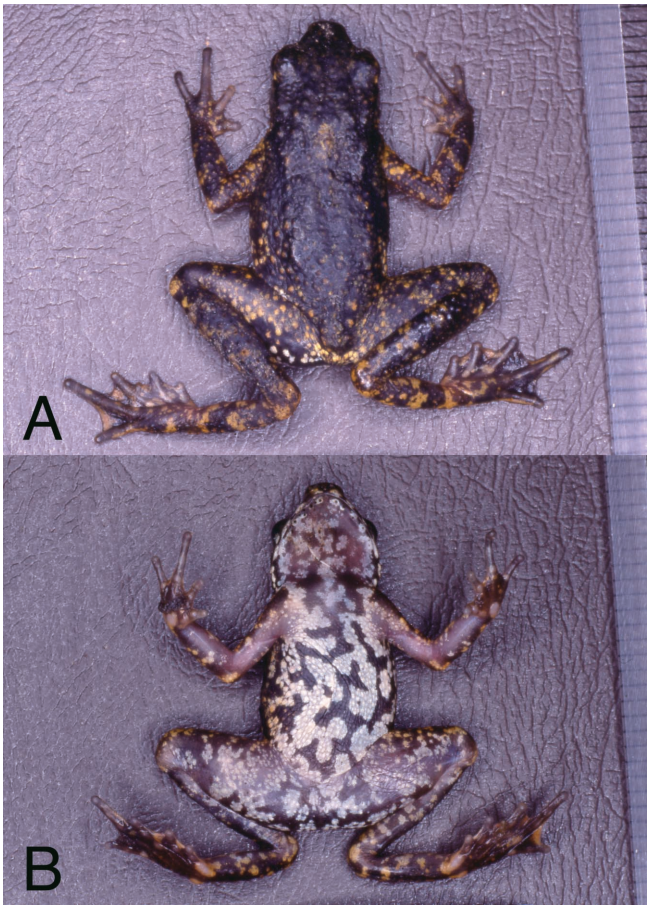

Fig. 1. Male holotype of *Ansonia kraensis* (KUHE 35053, SVL =22.0 mm): (A) dorsal and (B) ventral views.

Ngamprasertwong; KUHE 35062, an adult female, same locality as the holotype, collected 1 January 2002 by T. Ngamprasertwong; KUHE 35698, an adult female and KUHE 35699, an adult male, same locality as the holotype, collected 4–5 December 2004, by W. Khonsue; CUZM (Chulalongkorn University, Zoological Museum) (R) 2401, an adult female, CUZM (R) 2402, a young female, CUZM (R) 2403–2405, three adult males, same locality as the holotype, collected 4–5 December 2004, by W. Khonsue; THNHM (National Science Museum of Thailand) 03239, an adult female, THNHM 03240, an adult male, THNHM 03241, a young female, same locality as the holotype, collected from 4 to 5 December 2004, by W. Khonsue; IRSNB (Institut Royal des Sciences Naturelles de Belgique) 1930, an adult female, from Klong Hat Som Pen, Muang, Ranong, collected 1 September 2003, by O. S. G. Powels, C. Chimsunchart, and M. Sumontha.

Referred specimens

KUHE 35825, three tadpoles and KUHE 35824, a just metamorphosed juvenile, from Raksawarn Public Park, Ranong Spa, collected 23 August 1997 by M. Matsui; KUHE 35809–35823, 15 juveniles, from the same locality as the holotype, collected 4–5 December 2004 by W. Khonsue.

Description of holotype (measurements in mm)

Snout-vent length 22.0; head about as long (7.0) as broad (6.8); snout (2.9) slightly longer than eye (2.3), truncate, constricted in front of eyes, projecting, obliquely sloping in profile; canthus rostralis distinct; lores straight, vertical; lips little flared below eye; nostril at the level of symphysis of lower jaws; internarial distance (2.3) narrower than interorbital (2.7); latter at narrowest point wider than upper eyelid (1.8); tympanum distinct, diameter (1.5) two-thirds eye diameter and separated from eye by one-fourth of tympanum diameter (0.4); a longitudinal opening into median subgular vocal sac on left side of mouth.

Fingers not markedly slender; webbing reaching base of subarticular tubercle of each finger; first finger much shorter than second, length of first (1.3) shorter than diameter of eye; fourth finger longer than second; tips only slightly swollen and not forming distinctly spatulate disks wider than other phalanges; two outer ones very slightly wider than phalanges; diameter of third finger (0.6) about half diameter of tympanum; fingers without dermal fringes; subarticular tubercles weak; a weak, round outer palmar tubercle.

Hindlimb (34.4) about 2.2 times length of forelimb (15.4); tibia not long (11.2), heels slightly overlapping when limbs are held at right angles to body; tibiotarsal articulation of adpressed limb reaching anterior corner of eye; foot (9.2) much shorter than tibia; tips of toes swollen into small disks; fifth toe longer than third; toes strongly webbed, webbing forming broad sheet; webbing formula: I $^1/_2$-1 II $^1/_2$-2 III $^1/_2$-2$^1/_3$ IV 2-$^1/_2$ V; excision of membrane between two outer toes reaching proximal end of middle subarticular tubercle of fourth when toes are in contact; subarticular tubercles indistinct; two metatarsal tubercles, inner one flat, oval, length (1.4) subequal to length of first toe (1.6), outer one distinct; no tarsal fold.

Dorsum tuberculate with mixture of small and minute, weakly conical warts; ridges absent on forehead, interorbital, or parietal region; dorsal surfaces of limbs with mixture of large and small conical warts; skin of abdominal areas coarsely granulate, pectoral and gular region finely so.

Single row of weak, conical tubercles under mandible; nuptial pad of coarse asperities on dorsal surfaces of metacarpal and basal phalanx of first finger.

Color in life

Dorsum brown, with darker mark beginning at rear of eyes, surrounding oval, light orange interscapular spot, and diverging on sides of sacrum; another dark brown mark along urostyle; tips of warts on flank orange yellow; lore and lips barred with cream; limbs brown dorsally with wide, indistinct orange-yellow crossbars (Fig. 1A); ventral surfaces and gular region silvery white mottled with dark brown (Fig. 1B).

Variation

The average snout-vent length of eight females ($\bar{x}$±SD =25.3±1.4 mm) is larger than that of seven males (21.3±1.0 mm). Females have longer forelimbs and first fingers, shorter and narrower heads, narrower third finger disks, and narrower interorbital spaces, all relative to SVL, than males (Mann-Whitney U test, p<0.05, Table 1). Individuals are not markedly variable in coloration and pattern of marking. A juvenile just after metamorphosis had a SVL of 8.0 mm. Fifteen juveniles collected in early December had SVLs ranging from 8.6 to 16.9 mm ($\bar{x}$±SD=11.5±2.1 mm).

Larvae

Three tadpoles of stages (Gosner, 1960) 31 (TL=19.4 mm, HBL=7.3 mm), 34 (22.0 mm, 8.3 mm: Fig. 2), and 40 (23.0 mm, 8.1 mm) were examined. Head-body teardrop shaped, broadly rounded at snout; maximum width well

Fig. 2. Larval *Ansonia kraensis* (stage 34, total length=22.0 mm): (A) dorsal, (B) lateral and (C) ventral views.

Fig. 3. Oral disk of larval *Ansonia kraensis* (stage 34, oral disk width=4.6 mm).

anterior to center of eyes, 58% (median of three specimens) of HBL; body flattened below, depth 64% of head-body width; eyes dorsal, pointing outward, eyeball 11% of HBL; nostrils open, rim not raised, internarial subequal to interorbital and much less than distance from tip of snout. Oral disk (Fig. 3) ventral, width 99% of head-body width; both labia expanded; upper labium separated from snout by groove; a single row of short marginal papillae continuous across lower labium and on lateral corners of upper labium; two rows of low, widely spaced inframarginal labial papillae on lower labium except at corners; labial tooth raw formula 2/3, upper rows longer than the lower, well separated from jaw sheaths; jaw sheaths black, smooth, upper divided with gap 145% length of single sheath portion. Spiracle sinistral, low on side, tube attached to body wall, snout-spiracle distance 73% of HBL. Anal tube median, widely separated from ventral fin. Tail slender, margins straight, tapering only near end to sligthly pointed tip; tail length 166% of HBL, maximum depth 18% of tail length; caudal muscle deeper than fins until distal fourth; origin of dorsal fin well behind end of body, dorsal and ventral fins similarly deep; origin of ventral fin subequal to that of dorsal. No glands or lateral line pores visible.

Head-body dorsally black with two transverse light bands, anterior one a short distance behind eyes and posterior one at root of tail; ventrally head-body without pigment; caudal muscle dark except midventrally; dorsal fin dusky throughout; ventral fin dusky except for colorless proximal half.

Range

Known from the type locality, Punyaban waterfall, Raksawarn Public Park, Ranong Spa, and Klong Hat Som Pen, Muang, all Ranong Province, and Khao Lak, Phang Nga Province (Grossmann and Tillack, 2001: see below), Isthmus of Kra, Thailand (Fig. 4).

Natural history

In Ranong, *A. kraensis* was found along the bank of a mountain stream (width <5 m), perching on leaves of short grasses at night. Some were found near a seepage on the slope far (>30 m) from the stream. One of three females, collected in early December, had cream-white ova (diameter=1.6–1.7 mm) in the ovaries. Late December to late January seems to be outside the breeding season, as also indicated by the absence of calling males. Tadpoles and a just metamorphosed juvenile were collected in late August. Tadpoles were confined to areas of moderate current in a small stream (width <3 m), and were found clinging individually to bare rock in a shallow portion (depth <20 cm).

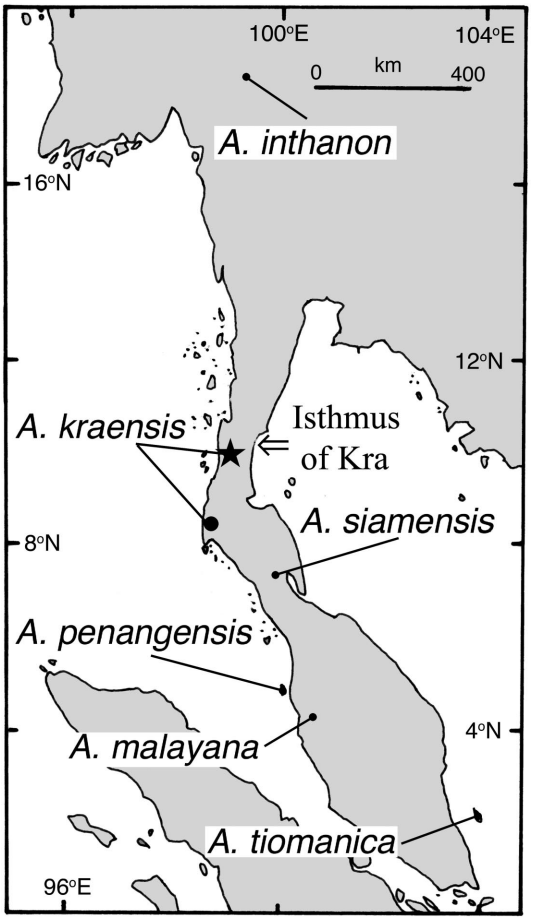

Fig. 4. Map of Southeast Asia showing the Malay Peninsula, Isthmus of Kra, and type localities of *Ansonia* species. Closed star and circle indicate the type and another known locality of *A. kraensis*, respectively.

Etymology

The specific name is derived from Isthmus of Kra, where this species occurs.

DISCUSSION

Ansonia kraensis is distinguished from some congeners by the combination of (1) tympanum visible externally, (2) first finger not reaching disk of second, and (3) no tarsal ridge. Two Philippine species (*A. mcgregori* [Taylor, 1922] and *A. muelleri* [Boulenger, 1887]), and *A. anotis* Inger, Tan, and Yambun, 2001 from Borneo lack a visible tympanum. In

A. glandulosa Iskandar and Mumpuni, 2004 (from Sumatra), *A. guibei* Inger, 1966, *A. spinulifer* (Mocquard, 1890), *A. longidigita* Inger, 1960 (all from Borneo), *A. leptopus* (Günther, 1872) (Borneo and Malay Peninsula), and *A. penangensis* Stoliczka, 1870 (Malay Peninsula), the first finger reaches the disk of the second. *Ansonia albomaculata* Inger, 1960 and *A. minuta* Inger, 1960, both from Borneo, possess a sharp tarsal ridge.

All the remaining species, *A. fuliginea* (Mocquard, 1890) (including *A. altitudinis* [Smith, 1931]), *A. hanitschi* Inger, 1960, *A. latidisca* Inger, 1966, *A. platysoma* Inger, 1960, *A. torrentis* Dring, 1984 (all from Borneo), *A. malayana* Inger, 1960, *A. tiomanica* Hendrickson, 1966 (from Malay Peninsula), *A. inthanon* Matsui, Nabhitabhata, and Panha, 1998, *A. siamensis* Kiew, 1985 (from Thailand), *A. ornata* Günther, 1876, *A. rubigina* Pillai and Pattabiraman, 1981 (from India), are similar to *A. kraensis* in having a visible tympanum and the first finger not reaching the disk of the second, and in lacking a tarsal ridge.

Of these, *A. hanitschi* (male SVL=23–27 mm, female SVL=29–32 mm; Inger, 1966), *A. tiomanica* (SVL=25.4–36.3 mm; Berry, 1975), *A. siamensis* (male SVL=25.5–27.9 mm, female SVL=32.2–34.6 mm; Matsui *et al*., 1998), *A. ornata* (SVL=27.0–30.6 mm; Matsui, unpublished data), *A. torrentis* (SVL=30.6–33.3 mm; Dring, 1983), *A. fuliginea* (male SVL=32–44 mm; Inger, 1966), *A. latidisca* (male SVL=35 mm; Inger, 1966) and *A. rubigina* (SVL=36–40.5 mm; Pillai and Pattabiraman, 1981) are larger than *A. kraensis* (male SVL=19.9–22.3 mm, female SVL=24.0–27.9 mm; Table 1). The remaining species, *A. platysoma* (SVL=20–25 mm; Inger, 1966), *A. malayana* (male SVL=20.0–22.0 mm, female SVL=25.0–27.6 mm; Matsui, unpublished data), and *A. inthanon* (male SVL=22.9–23.3 mm, female SVL=23.3–25.2 mm; Matsui *et al*., 1998), have a small body like *A. kraensis*.

In *A. platysoma*, the tympanum characteristically lies very close to the mouth, a condition not observed in all the other congeners, including *A. kraensis*. In *A. inthanon* and *A. malayana*, large yellow areas and yellow spots, respectively, are present on abdomen. In contrast, *A. kraensis* has the abdomen mottled with brown and white. *Ansonia inthanon* also has discrete bright yellow spots along the lower jaw that are absent in the new form. In the larval stage, *A. malayana* has upper jaw sheaths more widely separated than in *A. kraensis* (Matsui, unpublished data).

Three species of *Ansonia* (*A. malayana*, *A. siamensis* and *A. inthanon*) have been reported from southern Thailand (Inger, 1960; Kiew, 1984; Matsui *et al*., 1998). Of these, *A. malayan*a has been reported to occur from the Larut Hills (type locality) of Malaysia northward to the Isthmus of Kra (Matsui *et al*., 1998). However, actual distribution of the species in Thailand is not well known. A recent record of *A. malayana* from Khao Lak, Phang Nga Province (Grossmann and Tillack, 2001) is undoubtedly a misidentification of *A. kraensis*, as is clear from figures and measurements shown by Grossmann and Tillack (2001: 22–23).

However, older records of *A. malayana* from southern Thailand (Smith, 1917, 1922; Taylor, 1962 [as *A. penangensis*]) are not easily ascribed to misidentifications of *A. kraensis*. As already noted by Matsui *et al*. (1998), some specimens of nominal *A. malayana* from this region are reported to have larger yellow spots on the belly, more extentsive webbing, and larger body size than in Malaysian specimens (Inger, 1960). Except for the large body size, these specimens seem to resemble *A. inthanon* more than *A. kraensis*. Further field surveys, as well as inspection of museum specimens, are needed to resolve this distributional/taxonomic problem.

The present discovery of a new *Ansonia* in the Isthmus of Kra seems to be biogeographically significant, because specific distinction of *A. kraensis* and *A. malayana* suggests presence of similar cases in other anuran lineages between the northern and southern regions of Malay Peninsula that have been thought to encompass many amphibian species in common.

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