

## Three New Indochinese Species of Cascade Frogs (Amphibia: Ranidae) Allied to *Rana archotaphus*

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Three new frog species allied to *Rana archotaphus* are described from Laos and Vietnam. One new species from the Hoang Lien Mountains of northwestern Vietnam is characterized by having females with snout-vent length 66–68 mm, no visible pineal body, the first finger shorter than second, width of third finger disc about equal to tympanum diameter, and tympanum of males relatively larger than females. The second new species from northern Laos is characterized by having males with snout-vent length 38–44 mm, no visible pineal body, first finger shorter than second, width of third finger disc equal to the tympanum diameter, venter with very light or no spotting, and venter translucent. The third new species from the Northern Truong Son (Annamite Highlands) of Laos and the Kon Tum Plateau of Vietnam is characterized by having females with snout-vent length 56–57 mm, a visible pineal body, tympanum of males relatively equal to females, the first finger shorter than second, and males with width of third finger disc about half the tympanum diameter. Descriptions are expanded of several species that resemble the two new species: *Rana archotaphus*, *R. daorum*, *R. iriodes*, and *Amolops chunganensis*.

RECENT herpetological work in mainland Southeast Asia has resulted in the discovery of many new frog species of the family Ranidae that live in swift, rocky streams and have expanded digit tips (e.g., Bain et al., 2003; Orlov et al., 2003; Bain and Stuart, in press). These species are dorsoventrally compressed, with long, powerful legs, fully webbed feet, and sexual dimorphism in snout-vent length. They have been historically synonymized in error and hidden in natural history collections under other names due to their overall similarity, or only recently discovered in the wild. Although suspected to be cryptic species for some time (e.g., Werner, 1930; Taylor, 1962), detailed morphological and genetic study of these frog species have only been undertaken very recently (e.g., Inger and Chan-ard, 1997; Bain et al., 2003). Inger and Chan-ard (1997) described one of these species, *Rana archotaphus*, from northern Thailand. *Rana archotaphus* is distinguished by its medium body size (female snout-vent length 58.8–62.5), first finger shorter than second, expanded finger discs limited to outer three fingers, outer metatarsal tubercle, dorsolateral folds, and lack of sexual dimorphism in tympanum size. Recent herpetological surveys in Vietnam and Laos have resulted in the discovery of three previously unknown species superficially similar to *R. archotaphus*. They are described herein.

### MATERIALS AND METHODS

Institutional abbreviations are as listed in Leviton et al. (1985), except Institute of

Ecology and Biological Resources, Hanoi (IEBR) and Zoological Institute, St. Petersburg, Russian Academy of Sciences (ZISP). Specimens were preserved in 10% buffered formalin and later transferred to 70% ethanol. Tissue samples were taken from some individuals by preserving pieces of liver and/or muscle in 95% ethanol or 20% DMSO/EDTA-salt saturated storage buffer before the specimen was fixed in formalin. Specimens were deposited and comparative material was examined in the AMNH, IEBR, FMNH, and ZISP. Comparative material was also examined in the holdings of the Royal Ontario Museum (ROM). Specimens on long-term custodial loan to AMNH from IEBR are reported as AMNH/IEBR catalogue numbers. Collection localities in Vietnam and Laos are shown in Figure 1.

Measurements were made with dial calipers to the nearest 0.1 mm. Abbreviations used are: SVL = snout-vent length; HDL = head length, from tip of snout to rear of the jaws; HDW = maximum head width; SNT = snout length, from tip of snout to the anterior corner of the eye; EYE = diameter of the exposed portion of the eyeball; IOD = interorbital distance at narrowest point; TMP = horizontal diameter of tympanum; TEY = tympanum-eye distance from anterior edge of tympanum to posterior corner of the eye; TIB = tibia length; FEM = femur length, from vent to outer edge of knee; HND = hand length, from base of palm to tip of finger III; FTL = foot length, from proximal edge of inner metatarsal tubercle to tip of fourth toe.

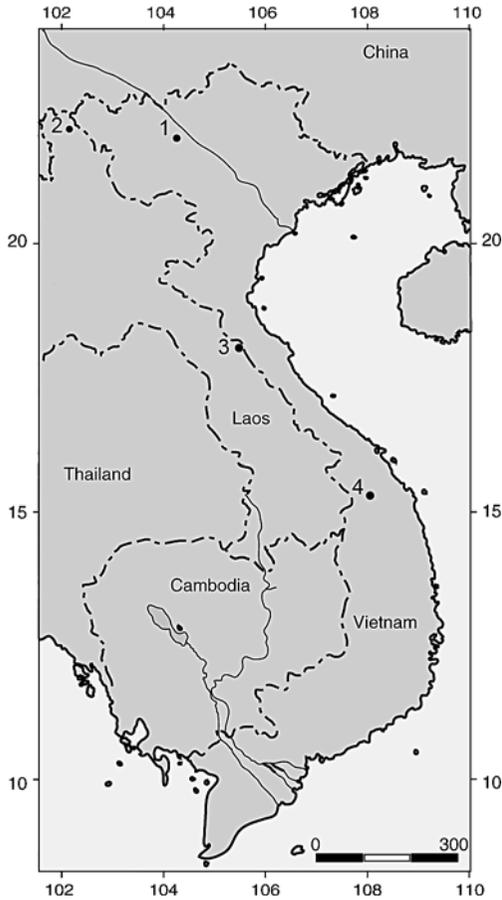


Fig. 1. Collection localities in Vietnam and Laos: (1) Van Ban District, Nam Tha Commune, Lao Cai Province, Vietnam; (2) Phou Dendin National Biodiversity Conservation Area, Phongsaly District, Phongsaly Province, Laos; (3) Nakai-Nam Theun National Biodiversity Conservation Area, Nakai District, Khammouan Province, Laos; (4) Dac Glei District, Kon Tum Province, Vietnam.

In addition to the three new species presented here, six other ranid species from mainland Southeast Asia have the character combination of SVL of females <70 mm, first finger shorter than the second, digit tips expanded with circummarginal grooves, dorsolateral folds, upper parts with smooth skin, males without humeral glands, and unpigmented eggs: *Rana archotaphus*, *R. daorum*, *R. iriodes*, *Amolops bellulus*, *A. chunganensis*, and *A. monticola*. Type material of *R. archotaphus*, *R. daorum*, *R. iriodes*, and *A. chunganensis* was examined (see Material Examined). Data for *A. monticola* were taken from the original description (Anderson, 1871) and Boulenger (1920), and data for *A. bellulus* were taken from the original description (Liu et al., 2000).

### *Rana cucae*, new species

Figures 2, 3

*Holotype*.—AMNH 168730 (Field Series 16445), adult male, Vietnam, Lao Cai Province, Van Ban District, Nam Tha Commune, collected along a tributary of the Nam Tha River in submontane evergreen forest, near 21°55'23"N, 104°22'43"E, 640 m elevation, 3 Sept. 2004, Raoul H. Bain, Nguyen Quang Truong, Doan Van Kien, and Lu A Cho.

*Paratypes*.—AMNH 168729 (one male), same data as holotype except collected on 2 Sept. 2004. AMNH 168731, 168803/IEBR 1582 (two males), same data as holotype, except collected by Raoul H. Bain, Nguyen Quang Truong, Doan Van Kien, and Treu Tai Vuong. AMNH 168726–28, AMNH 168802/IEBR 1583 (four females), same data as holotype except collected 2–4 Sept. 2004.

*Diagnosis*.—A ranid frog having females with SVL 65.9–68.0; no visible pineal body; tympanum of males relatively larger than tympanum of females; males with gular pouches; first finger shorter than second, no movable flap of skin on preaxial side of fingers II and III; digit tips expanded, equal to or slightly greater than tympanum diameter, with circummarginal grooves; an outer metatarsal tubercle; weak glandular dorsolateral fold beginning at rear of head, upper parts with smooth skin; males without humeral gland; dorsum blue-green in preservative; gray-brown spotting on venter; and unpigmented eggs.

*Rana cucae* differs from *R. archotaphus* by having all fingertips expanded (outer three fingers expanded in *R. archotaphus*), having tympanum of males relatively larger than tympanum of females (no dimorphism in *R. archotaphus*), lacking a visible pineal body (present in *R. archotaphus*), and having larger females (*R. cucae* SVL 65.9–68.0; *R. archotaphus* SVL 58.8–62.5). *Rana cucae* differs from *R. daorum* by having larger females (*R. cucae* SVL 65.9–68.0, *R. daorum* SVL 53.3–57.6), having males with larger TMP : EYE than females (females with larger TMP : EYE in *R. daorum*), lacking a visible pineal body (present in *R. daorum*), and lacking a row of white spinules on dorsolateral fold and posterior corner of upper eyelid (present in *R. daorum*). *Rana cucae* differs from *R. iriodes* by having two oblique vomerine ridges (crescent-shaped in *R. iriodes*), lacking a visible pineal body (present in *R. iriodes*), having larger females (*R. cucae* SVL 65.9–68.0, *R. iriodes* SVL 61.9), and lacking a glandular gold-white flank spot (present in *R. iriodes*). *Rana cucae* differs from *A. bellulus* by



Fig. 2. Holotype male (AMNH 168730) and paratype female (AMNH 168727) of *Rana cucae* in amplexus.

having a circummarginal groove on the tip of the first finger (absent in *A. bellulus*), having males with gular pouches (absent in *A. bellulus*), and having dorsum light green (sandy beige with olive green and brown spots in *A. bellulus*). *Rana cucae* differs from *A. chunganensis* by having larger females (*R. cucae* SVL 65.9–68.0; *A. chunganensis* SVL 53.5), having males with smaller TMP : EYE (*R. cucae* 0.38–0.50, holotype of *A. chunganensis* 0.63), having all finger tips expanded (outer three fingers expanded in *A. chunganensis*), lacking spinules (*A. chunganensis* with small spinules on some dorsal surfaces and around vent), and having a green dorsum (reddish-brown in *A. chunganensis*). *Rana cucae* differs from *A. monticola* by having a weak glandular dorsolateral fold beginning at rear of head (beginning above tympanum in *A. monticola*), having an outer metatarsal tubercle (absent in *A. monticola*), and having gray-brown spotting on venter (absent in *A. monticola*).

*Description of holotype.*—Habitus moderately slender; head narrow, longer than wide; snout obtusely pointed in dorsal view, projecting beyond lower jaw, round in profile, not depressed; nostril lateral, midway between tip of snout and eye; canthus rostralis distinct, slightly constricted behind nostrils; lores concave and oblique; eye diameter 74% of snout length; interorbital distance greater than width of upper eyelid; pineal body not visible; distinct, round tympanum, covered by layer of skin, 46% eye diameter, not depressed relative to skin of temporal region, tympanic rim not elevated relative to tympanum; vomerine teeth strongly developed, on two oblique ridges, equal in distance from each other as to choanae; tongue cordiform, deeply notched posteriorly, free for approximately two-thirds its length; vocal sac opening on floor of mouth at corner; sac-like gular pouch, front margin positioned near to level of center of orbit.

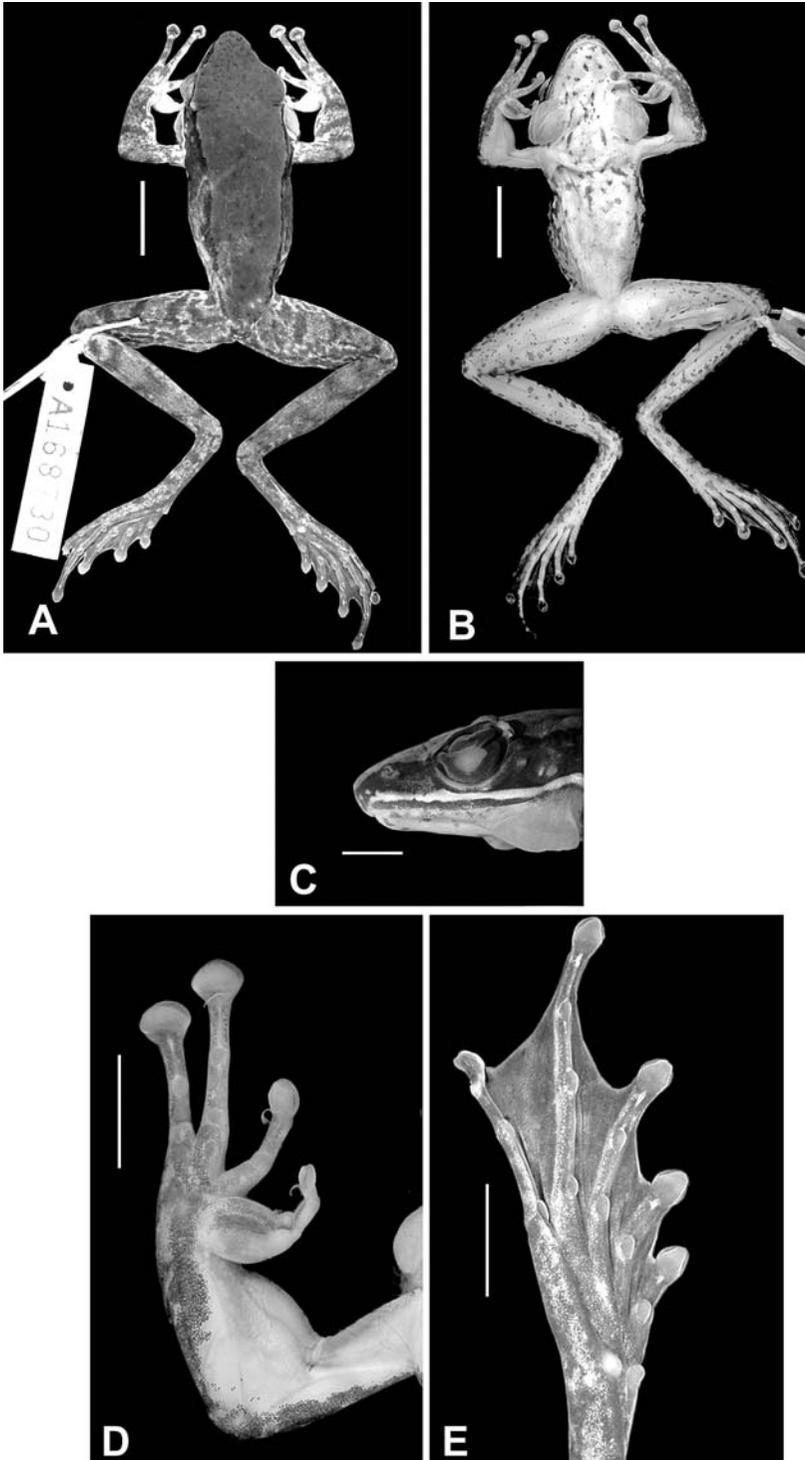


Fig. 3. Holotype of *Rana cucae* (AMNH 168730): (A) dorsal and (B) ventral view of body (scales = 10 mm); (C) head in lateral view (scale = 5 mm); (D) palmar view of right hand (scale = 5 mm); (E) palmar view of right foot (scale = 5 mm).

Tips of all four fingers expanded with circum-marginal grooves; width of finger III disc about two times width of phalanx, equal to diameter of tympanum; relative finger lengths  $I < II < IV < III$ ; ventral callous pad on fingers II, III, and IV from distal edge of proximal subarticular tubercle to base of disc; no movable flap of skin on preaxial side of fingers II and III; one subarticular tubercle on fingers I and II, two subarticular tubercles on fingers III and IV; one supernumerary tubercle proximal to proximal subarticular tubercle on fingers II, III, and IV; two palmar tubercles, oval, in contact; velvety nuptial pad on finger I, covering dorsal surface to level of distal edge of subarticular tubercle, covering medial surface to base of finger disc; forearm very robust.

Tips of toes expanded, width of toe IV disc smaller than width of finger III disc; toe III shorter than toe V; toes I, II, III, and V fully webbed to base of discs; toe IV fully webbed to distal subarticular tubercle with narrow extension to base of disc; movable flap of skin on preaxial side of toe I and postaxial side of V to level of proximal subarticular tubercle; elongate, oval inner metatarsal tubercle; round, outer metatarsal tubercle.

Skin smooth on all surfaces except granular on posterior surface of thigh; no humeral gland; no supratympanic fold; two rictal glands, anterior gland continuous with upper lip; weak glandular dorsolateral fold from rear of head to near vent.

Measurements (mm) of holotype: SVL 40.9; HDL 16.4; HDW 13.7; SNT 6.8; EYE 5.0; IOD 4.8; TMP 2.3; TEY 1.6; TIB 25.7; FEM 21.4; HND 12.6; FTL 20.8.

*Coloration of holotype in life.*—Dorsum light green; side of head black from tip of snout, diffusing posterior to axilla, continuing as black streak below edge of dorsolateral fold; orange-pink blotch in contact with upper lip at base of lores; yellow lip stripe from tip of snout to posterior of arm insertion; upper one-fourth of iris gold, lower three-fourths dark; narrow gold stripe on edge of canthus from tip of snout along margin of upper eyelid continuing above edge of dorsolateral fold; flank dark brown anteriorly, diffusing to yellowish-brown posteriorly; dorsal surface of limbs light brown with narrow, diffuse dark brown crossbars, interspersed with small dark brown spots; underside of lower jaw, throat, chest, and belly yellow-gold, with gray-brown spotting on chin, gray-brown elongated markings on throat, gular pouch, chest, and anterior half of belly; black axillary spot posterior to gular pouch; ventral surface of hindlimb creamy-yellow with dark brown speckling, except

near vent; nuptial pad white; outer metatarsal tubercle white; foot webbing gray with dark gray spots.

*Coloration of holotype in preservative.*—Dorsum fades to blue-green, with a few brown spots on back and sacrum, more concentrated on top of head; narrow stripe on edge of canthus from tip of snout to above edge of dorsolateral fold fades to light gray; blotch in contact with upper lip at base of lores fades to light gray; posterior portion of flank and anterior surface of thigh near groin fades to whitish-gray with dark marbling; posterior surface of thigh yellowish-brown with dark brown marbling; yellow on outer margins of lower jaw and belly; ventral surface of hindlimbs fades to creamy-white with dark brown speckling; foot webbing gray with dark gray flecking, outer margin white.

*Variation.*—Measurements of paratypes summarized in Table 1. Snout-vent length of adult males 60–68% SVL of adult females; tympanum of males relatively larger than tympanum of females (Table 1). Width of finger III disc slightly larger than diameter of tympanum in some females. Ova in preservative uniformly yellow, without pigmented hemisphere, approximately 2 mm diameter. Red subcutaneous vascularization visible on flank of gravid females. Dorsolateral fold in preservative more visible in paratypes. Blotch in contact with upper lip at base of lores in life sometimes green. Some males with pink nuptial pad in life. Flank in life sometimes orange-pink or yellow, without dark brown marbling. Dorsal surface of limbs in life sometimes orange-pink with dark brown crossbars or dark brown with black crossbars. Hindlimbs in life sometimes green between dark crossbars.

*Distribution and ecology.*—Currently, *R. cucae* is known only from the Nam Tha River and its tributaries at 640 m elevation in Nam Tha Commune, Van Ban District, Lao Cai Province, Vietnam. The species was collected on riverside banks, on rocks in the torrent, and on low-lying branches (0.5–1 m) adjacent to the water. The Nam Tha is a very wide (greater than 20 m), fast moving river with alternating cascades, rapids, glides, and side pools. In the area where *R. cucae* was found, the Nam Tha is completely forested on both sides. Tributaries of the Nam Tha are fast flowing, varying in width from 1–12 m, with many large boulders, cascades, rapids, short glides, and some deep side pools. At their heads, the tributaries had very dense canopy cover with low-lying vegetation. All rivers and streams in the

TABLE 1. MEASUREMENTS (MM) OF ADULT TYPE SPECIMENS OF *Rana cucaea*, NEW SPECIES; *Rana vitrea*, NEW SPECIES; AND *Rana compitrix*, NEW SPECIES. Abbreviations defined in the text.

Measurement	<i>R. cucaea</i> males		<i>R. vitrea</i> males		<i>R. compitrix</i> males		<i>R. compitrix</i> females	
	Range; Mean $\pm$ S.D. (n = 4)	Range; Mean $\pm$ S.D. (n = 4)	Range; Mean $\pm$ S.D. (n = 7)	Range; Mean $\pm$ S.D. (n = 10)	Range; Mean $\pm$ S.D. (n = 10)	Range; Mean $\pm$ S.D. (n = 3)		
SVL	40.7-44.6; 42.2 $\pm$ 1.8	65.8-68.0; 66.7 $\pm$ 1.0	37.5-43.6; 40.7 $\pm$ 2.3	31.4-42.6; 36.8 $\pm$ 3.1	55.8-56.9; 56.4 $\pm$ 0.7			
HDL	15.9-17.3; 16.5 $\pm$ 0.4	22.9-24.2; 23.4 $\pm$ 0.6	13.9-16.3; 15.5 $\pm$ 0.8	12.3-14.6; 13.6 $\pm$ 0.8	19.0-20.1; 19.4 $\pm$ 0.6			
HDW	13.3-14.5; 14.0 $\pm$ 0.6	20.6-21.2; 20.9 $\pm$ 0.3	11.2-14.1; 12.4 $\pm$ 1.0	10.1-13.3; 11.6 $\pm$ 1.0	16.8-18.2; 17.5 $\pm$ 0.7			
SNT	6.6-7.3; 6.9 $\pm$ 0.3	9.3-10.4; 9.9 $\pm$ 0.5	6.1-6.4; 6.9 $\pm$ 0.3	4.9-5.9; 5.4 $\pm$ 0.3	7.7-8.2; 7.9 $\pm$ 0.3			
EYE	5.0-6.4; 5.5 $\pm$ 0.6	7.1-7.8; 7.5 $\pm$ 0.3	4.3-5.5; 4.8 $\pm$ 0.4	4.5-5.6; 4.9 $\pm$ 0.4	6.8-7.1; 6.9 $\pm$ 0.2			
IOD	4.1-4.8; 4.5 $\pm$ 0.3	6.0-7.0; 6.6 $\pm$ 0.4	3.5-4.5; 4.0 $\pm$ 0.4	3.2-4.2; 3.6 $\pm$ 0.3	5.4-6.0; 5.6 $\pm$ 0.4			
TMP	2.1-2.8; 2.4 $\pm$ 0.3	2.7-3.0; 2.8 $\pm$ 0.1	1.8-2.4; 2.1 $\pm$ 0.2	1.8-2.6; 2.3 $\pm$ 0.2	2.9-3.1; 3.0 $\pm$ 0.1			
TEY	1.3-2.6; 1.7 $\pm$ 0.6	2.6-3.2; 2.9 $\pm$ 0.3	1.1-1.7; 1.3 $\pm$ 0.2	1.0-1.7; 1.3 $\pm$ 0.2	1.8-2.1; 2.0 $\pm$ 0.1			
TIB	25.7-27.6; 26.6 $\pm$ 0.8	38.4-43.5; 40.7 $\pm$ 2.5	23.3-27.5; 25.2 $\pm$ 1.4	17.9-24.3; 22.3 $\pm$ 1.6	31.9-35.2; 33.4 $\pm$ 1.6			
FEM	21.4-23.3; 22.7 $\pm$ 0.8	34.0-36.3; 35.4 $\pm$ 1.0	18.7-21.6; 20.4 $\pm$ 1.0	15.2-22.9; 18.4 $\pm$ 2.7	26.7-29.1; 28.2 $\pm$ 1.4			
HND	12.6-14.7; 13.5 $\pm$ 1.0	17.6-19.3; 18.5 $\pm$ 0.9	10.9-12.4; 11.5 $\pm$ 0.6	8.3-13.0; 10.6 $\pm$ 1.5	15.0-15.9; 15.5 $\pm$ 0.5			
FIL	20.7-22.9; 21.3 $\pm$ 0.8	31.7-34.5; 33.6 $\pm$ 1.2	18.7-22.2; 20.5 $\pm$ 1.4	14.7-23.7; 18.7 $\pm$ 2.6	26.9-28.9; 27.8 $\pm$ 1.0			
	Range; Median	Range; Median	Range; Median	Range; Median	Range; Median			
HDL : HDW	1.13-1.29; 1.20	1.11-1.16; 1.11	1.14-1.37; 1.25	1.08-1.29; 1.17	1.09-1.14; 1.10			
SNT : HDL	0.41-0.42; 0.42	0.41-0.44; 0.42	0.40-0.45; 0.41	0.36-0.45; 0.40	0.40-0.41; 0.41			
TMP : EYE	0.38-0.50; 0.44	0.35-0.39; 0.37	0.36-0.51; 0.43	0.41-0.51; 0.47	0.41-0.45; 0.44			
EYE : SNT	0.69-0.93; 0.79	0.68-0.84; 0.76	0.65-0.85; 0.74	0.79-1.04; 0.92	0.84-0.91; 0.88			
TIB : SVL	0.59-0.66; 0.64	0.57-0.66; 0.61	0.60-0.64; 0.62	0.56-0.66; 0.61	0.57-0.62; 0.58			

area are geomorphologically variable: bottoms vary from rocky to sandy; banks vary from steep and rocky to low with humus and vegetation. *Rana cucae* was also found inside the forest (submontane) within 100 m of water on the forest floor, on logs, and in trees (up to ~4 m). Forest in Nam Tha Commune is composed of stands of mixed hardwood (DBH ~25 cm), bamboo, and banana.

Males were calling from leaves on small branches (0.5–4 m above the ground) directly beside streams. The call consisted of a single, high-pitched squeak. Two pairs were seen in axillary amplexus: AMNH 168729 with 168726 and the holotype (AMNH 168730) with AMNH 168727 (Fig. 2). Tadpoles are unknown.

*Etymology*.—The specific epithet is a matronym honoring Mrs. Ho Thu Cuc, senior herpetologist at the Institute of Ecology and Biological Resources, Hanoi. Mrs. Cuc's humor, friendship, and outstanding collaborative efforts are greatly appreciated and have benefited the research of Vietnam's amphibian fauna.

***Rana vitrea*, new species**

Figure 4

*Holotype*.—FMNH 258182 (HKV 64300), adult male, Laos, Phongsaly Province, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, collected on a stream bank near Nam Khang River in hilly evergreen forest, near 22°09'04"N, 102°12'19"E, 600 m elevation, 14 Oct. 1999, Bryan L. Stuart and Harold F. Heatwole.

*Paratypes*.—FMNH 258183–258186 (four males), same data as holotype. FMNH 258180 (one male), Laos, Phongsaly Province, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, collected from a small stream near Nam Ou River, near 22°05'38"N, 102°12'50"E, 600 m elevation, 7 Oct. 1999, Bryan L. Stuart and Harold F. Heatwole. FMNH 258187 (one male), Laos, Phongsaly Province, Phongsaly District, Phou Dendin National Biodiversity Conservation Area, collected from Houay Aw Stream, near the Nam Ou River, near 22°05'44"N, 102°08'10"E, 600–800 m elevation, 23 Oct. 1999, Bryan L. Stuart and Harold F. Heatwole.

*Diagnosis*.—A ranid frog having slender habitus; males with SVL 37.5–43.6; no visible pineal body; males with gular pouches; first finger shorter than second, no movable flap of skin on preaxial side of fingers II and III; digit tips

expanded with circummarginal grooves; an outer metatarsal tubercle; weak glandular dorso-lateral fold beginning at posterior corner of upper eyelid; all surfaces except posterior portion of thigh with smooth skin; males without humeral gland; dorsum gray-green in preservative with brown spots concentrated near sacrum; venter with very light or no spotting, and translucent.

*Rana vitrea* differs from *R. archotaphus* by having all fingertips expanded (outer three fingers expanded in *R. archotaphus*), lacking a visible pineal body (present in *R. archotaphus*), having very few or no elongated markings on venter (elongated markings distinctly visible in *R. archotaphus*), and having skin on venter translucent (not translucent in *R. archotaphus*). *Rana vitrea* differs from *R. cucae* by having a more slender, gracile habitus, having dorsum in preservative gray-green with large brown spots concentrated near sacrum (blue-green with brown spots concentrated on head in *R. cucae*), having very few or no elongated markings on venter (elongated markings distinctly visible in *R. cucae*), and having skin on venter translucent (not translucent in *R. cucae*). *Rana vitrea* differs from *R. daorum* by having slightly larger SVL in males (*R. vitrea* 37.5–43.6, *R. daorum* 32.0–38.1), lacking a visible pineal body (present in *R. daorum*), and lacking a row of white spinules on dorsolateral fold and posterior corner of upper eyelid (present in *R. daorum*). *Rana vitrea* differs from *R. iriodes* by having two oblique vomerine ridges (crescent-shaped in *R. iriodes*), lacking a visible pineal body (present in *R. iriodes*), and lacking a glandular gold-white flank spot (present in *R. iriodes*). *Rana vitrea* differs from *A. bellulus* by having a circummarginal groove on the tip of the first finger (absent in *A. bellulus*) and having males with gular pouches (absent in *A. bellulus*). *Rana vitrea* differs from *A. chunganensis* by having males with smaller TMP : EYE (*R. vitrea* 0.36–0.51, holotype of *A. chunganensis* 0.63), having all finger tips expanded (outer three fingers expanded in *A. chunganensis*), lacking spinules (small spinules on some dorsal surfaces and around vent in *A. chunganensis*), and having a green dorsum (reddish-brown in *A. chunganensis*). *Rana vitrea* differs from *A. monticola* by having oblique vomerine ridges that converge anteriorly (ridges converge posteriorly in *A. monticola*), lacking a supratympanic fold (present in *A. monticola*), and having an outer metatarsal tubercle (absent in *A. monticola*).

*Description of holotype*.—Habitus slender; head narrow, longer than wide; snout obtusely

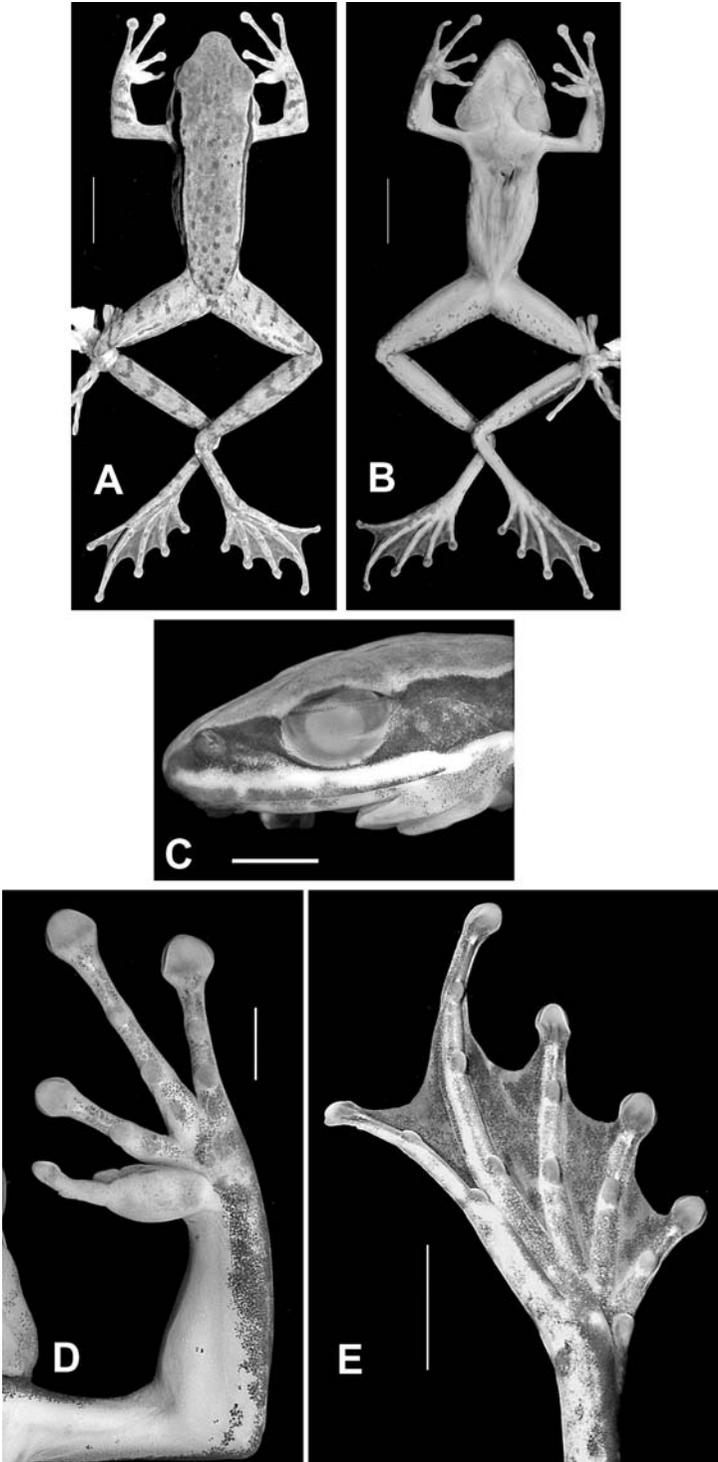


Fig. 4. Holotype of *Rana vitrea* (FMNH 258182): (A) dorsal and (B) ventral view of body (scales = 10 mm); (C) head in lateral view (scale = 5 mm); (D) palmar view of right hand (scale = 2.5 mm); (E) palmar view of right foot (scale = 5 mm).

pointed in dorsal view, projecting beyond lower jaw, round in profile, not depressed; nostril lateral, slightly closer to eye than tip of snout; canthus rostralis distinct, slightly constricted behind nostrils; lores oblique, shallowly concave; eye diameter 67% of snout length; interorbital distance greater than width of upper eyelid; pineal body not visible; distinct, round tympanum, covered by layer of skin, 52% eye diameter, not depressed relative to skin of temporal region, tympanic rim not elevated relative to tympanum; vomerine teeth strongly developed, on two oblique ridges, equal in distance from each other as to choanae; tongue cordiform, deeply notched posteriorly, free for approximately two-thirds its length; vocal sac opening on floor of mouth at corner; sac-like gular pouch, front margin positioned near to level of center of orbit.

Tips of all four fingers expanded with circum-marginal grooves, finger I with indistinct circum-marginal groove; width of finger III disc about 1.5 times width of phalanx, equal to diameter of tympanum; relative finger lengths  $I < II < IV < III$ ; ventral callous pad on fingers II, III, and IV from distal edge of proximal subarticular tubercle to base of disc; no movable flap of skin on preaxial side of fingers II and III; one subarticular tubercle on fingers I and II, two subarticular tubercles on fingers III and IV; one supernumerary tubercle proximal to proximal subarticular tubercle on fingers II, III, and IV; two palmar tubercles, oval, in contact; velvety nuptial pad on finger I, covering dorsal surface to level of distal edge of subarticular tubercle, covering medial surface to base of finger disc; forearm robust.

Tips of toes expanded, width of toe IV disc smaller than width of finger III disc; toe III shorter than toe V; toes I, II, III, and V fully webbed to base of discs; toe IV fully webbed just distal to proximal subarticular tubercle with narrow extension to base of disc; movable flap of skin on preaxial side of toe I; movable flap of skin on postaxial side of toe V to level of proximal subarticular tubercle; elongate, oval inner metatarsal tubercle; round, outer metatarsal tubercle.

Skin smooth on all surfaces except granular on posterior surface of thigh; no humeral gland; no supratympanic fold; two rictal glands, anterior gland continuous with upper lip; weak glandular dorsolateral fold from posterior corner of upper eyelid to near vent; entire ventral surface translucent.

Measurements (mm) of holotype: SVL 42.5; HDL 16.2; HDW 13.0; SNT 6.9; EYE 4.6; IOD 4.2;

TMP 2.4; TEY 1.3; TIB 25.4; FEM 21.6; HND 11.9; FTL 22.1.

*Coloration of holotype in preservative.*—Dorsum gray-green with dark brown stippling and large brown spots that concentrate near sacrum; upper eyelids darker green without any stippling or spots; side of head dark brown from tip of snout, continuing as narrow streak below edge of dorsolateral fold; gray blotch in contact with upper lip at base of lores; white upper lip stripe, extending from tip of snout to posterior of arm insertion; rictal glands yellow; lower lip stippled brown; narrow yellow-gray stripe on edge of canthus from tip of snout along margin of upper eyelid continuing above edge of dorsolateral fold; upper portion of flank gray-green with brown spots as on dorsum; lower half of flank creamy white, with brown mottling; axial and inguinal areas immaculate white; dorsal surface of limbs light brown with narrow, dark brown crossbars, interspersed with small dark brown spots; posterior portion of thigh creamy white with brown longitudinal markings near vent, network of dark brown and yellow near knee; venter cream, with a few, brown, very lightly stippled markings on lower jaw, throat, gular sacs, chest, and outer margins of belly; outer margins of jaws and belly with yellow pigment; black axillary spot posterior to gular pouch; ventral surface of hindlimb almost creamy-yellow, with loosely grouped dark brown stippling; nuptial pad white; outer metatarsal tubercle white; foot webbing gray with white network, and white outer margin; upper surface of toe discs red-brown.

*Variation.*—Measurements of paratypes summarized in Table 1. Some paratypes with nostril equidistant from eye and tip of snout. Some paratypes with toe IV fully webbed to level of distal subarticular tubercle. Condition of post-axial flap on toe V varies from absent to weakly present to distinctly present, sometimes with conditions differing on feet of same individual. Ventral markings vary from very lightly stippled as in holotype to immaculate. Upper surface of toe discs of paratypes gray.

*Distribution and ecology.*—*Rana vitrea* is currently known only from Phou Dendin National Biodiversity Conservation Area, Phongsaly District, Phongsaly Province, Laos. The species was collected from foliage of bushes in hilly evergreen forest within 2 m of small streams from 600–800 m elevation. Two specimens (FMNH 258180, 258187) were calling when

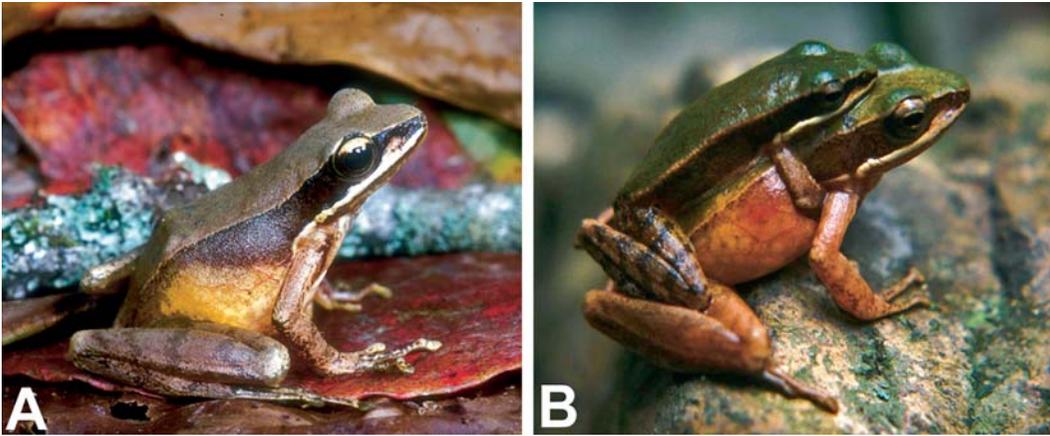


Fig. 5. *Rana compotrix* type specimens from Vietnam and Laos: (A) female from Kon Tum Province, Vietnam; and (B) male and female in amplexus from Nakai-Nam Theun National Biodiversity Conservation Area, Nakai District, Khammouan Province, Laos.

collected, the latter from a bush 1.5 m above the ground. Females and tadpoles remain unknown.

*Etymology*.—The specific epithet is taken from *vitreus* (L.) for glassy, in reference to the translucent belly skin of the new species.

***Rana compotrix*, new species**

Figures 5, 6

*Holotype*.—FMNH 256500 (field tag HKV 62806), adult male, Laos, Khammouan Province, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area, 3 m from Houay Ting Tou Stream in evergreen forest, collected on a tree 1.5 m above the ground, 17°58'N, 105°34'E, 700 m elevation, 7 Nov. 1998, Bryan L. Stuart.

*Paratypes*.—FMNH 256496–99, 256501 (five males), same data as holotype except collected 6–9 Nov. 1998. FMNH 256502, 256504 (two males), FMNH 256503 (one female), Laos, Khammouan Province, Nakai District, Nakai-Nam Theun National Biodiversity Conservation Area, collected in Houay Duen Stream, 17°57'N, 105°34'E, 700 m elevation, 10–13 Nov. 1998, Bryan L. Stuart. ZISP A7365, A7367–69 (four males), A7364, A7366 (two females), Vietnam, Kon Tum Province, Dak Glei District (formerly part of Dak To District), collected in Po Xi Stream between Mang Xang and Ngoc Lay Villages, 15°05'30"N, 107°57'10"E, 1500 m elevation, Sept. 1998, Nikolai L. Orlov.

*Diagnosis*.—A ranid frog having females with SVL 55.6–56.9; pineal body visible; relative tympanum diameter of males equal to females; males with gular pouches; first finger shorter than second, no movable flap of skin on preaxial side of fingers II and III; digit tips expanded with circummarginal grooves, males with width of finger III disc about half tympanum diameter; an outer metatarsal tubercle; weak glandular dorso-lateral fold from posterior corner of upper eyelid to near vent, upper parts with smooth skin; males without humeral gland; male dorsum blue-green in preservative, females blue-green to yellowish-green; brown spotting on venter; and unpigmented eggs.

*Rana compotrix* differs from *R. archotaphus* by having all fingertips expanded (outer three fingers expanded in *R. archotaphus*) and having males with width of finger III disc about half TMP (finger III disc  $\geq$  TMP in *R. archotaphus*). *Rana compotrix* differs from *R. cucae* by having smaller females (*R. compotrix* SVL 55.6–56.9; *R. cucae* SVL 65.8–68.0), having tympanum of males not relatively larger than tympanum of females (tympanum of males relatively larger than tympanum of females in *R. cucae*), having males with width of finger III disc about half TMP (finger III disc  $\geq$  TMP in *R. cucae*), and having a visible pineal body (absent in *R. cucae*). *Rana compotrix* differs from *R. daorum* by having males and females with equal TMP : EYE (females with larger TMP : EYE in *R. daorum*), having males with width of finger III disc about half TMP (finger III disc  $\geq$  TMP in *R. daorum*), and lacking a row of white spinules

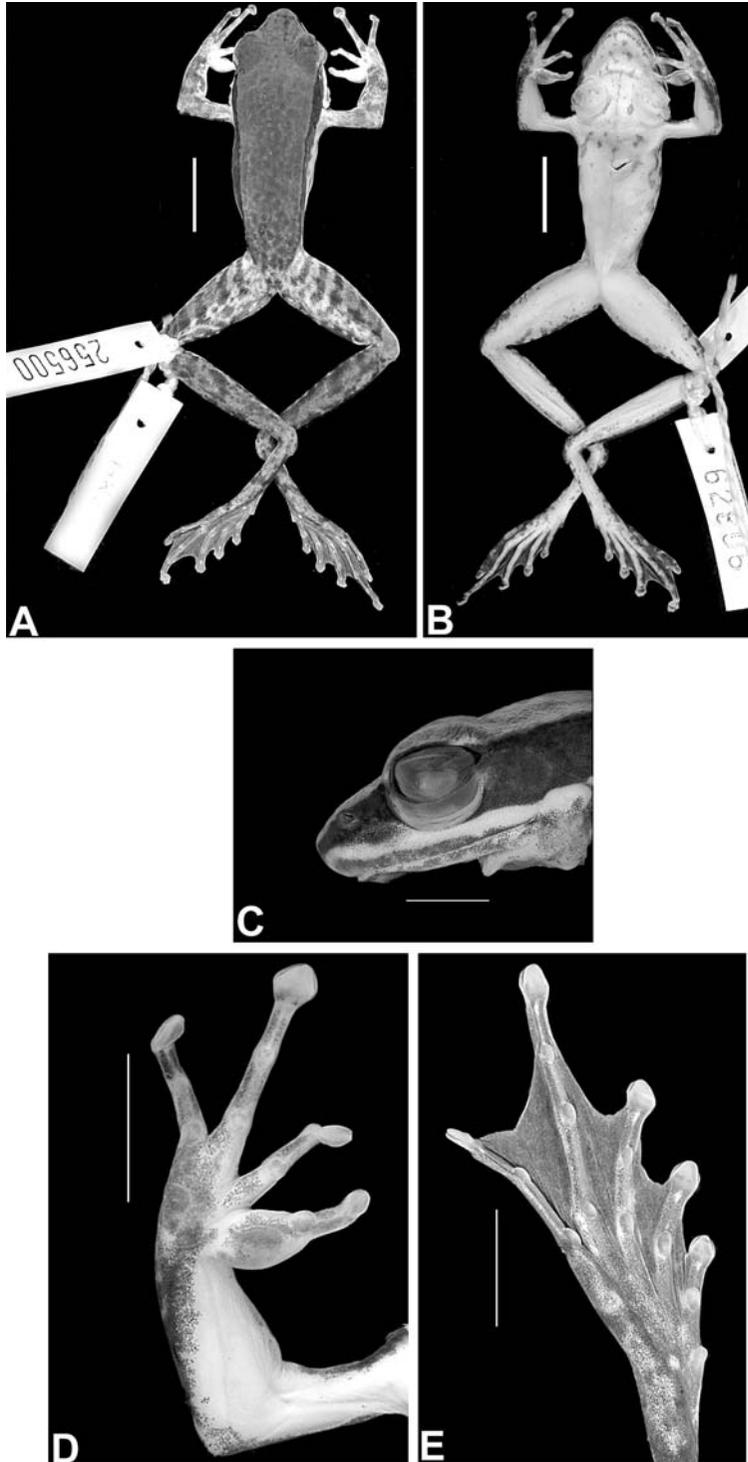


Fig. 6. Holotype of *Rana compotrix* (FMNH 256500): (A) dorsal and (B) ventral view of body (scales = 10 mm); (C) head in lateral view (scale = 5 mm); (D) palmar view of right hand (scale = 5 mm); (E) palmar view of right foot (scale = 5 mm).

on dorsolateral fold and posterior corner of upper eyelid (present in *R. daorum*). *Rana compotrix* differs from *R. iriodes* by having smaller females (*R. compotrix* SVL 55.6–56.9, female *R. iriodes* SVL 61.9), having two oblique vomerine ridges (rescent-shaped in *R. iriodes*), having males with width of finger III disc about half TMP (finger III disc  $\geq$  TMP in *R. iriodes*), and lacking a glandular gold-white flank spot (present in *R. iriodes*). *Rana compotrix* differs from *R. vitrea* by having a visible pineal body (absent in *R. vitrea*), having males with width of finger III disc about half TMP (finger III disc = TMP in *R. vitrea*), having very few or no elongated markings on venter (elongated markings distinctly visible in *R. vitrea*), and having a venter that is not translucent (venter translucent in *R. vitrea*). *Rana compotrix* differs from *A. bellulus* by having a circummarginal groove on the tip of the first finger (absent in *A. bellulus*) and having males with gular pouches (absent in *A. bellulus*). *Rana compotrix* differs from *A. chunganensis* by having males with smaller TMP : EYE (*R. compotrix* 0.41–0.51, holotype of *A. chunganensis* 0.63), having all finger tips expanded (outer three fingers expanded in *A. chunganensis*), and lacking spinules (*A. chunganensis* with small spinules on some dorsal surfaces and around vent). *Rana compotrix* differs from *A. monticola* by having smaller females (*R. compotrix* SVL 55.6–56.9; *A. monticola* SVL 65), having disc of finger III about half TMP (equal to or a little smaller than TMP in *A. monticola*), having toe discs equal in size to finger discs (toe discs smaller than finger discs in *A. monticola*), having an outer metatarsal tubercle (absent in *A. monticola*), and having brown mottling on venter (absent in *A. monticola*).

*Description of holotype*.—Habitus moderately slender; head narrow, longer than wide; snout obtusely pointed in dorsal view, projecting beyond lower jaw, round in profile, not depressed; nostril lateral, midway between tip of snout and eye; canthus rostralis distinct, slightly constricted behind nostrils; lores concave and oblique; eye diameter 90% of snout length; interorbital distance less than width of upper eyelid; pineal body visible; distinct, round tympanum, covered by layer of skin, 42% eye diameter, not depressed relative to skin of temporal region, tympanic rim not elevated relative to tympanum; vomerine teeth on two oblique ridges, slightly closer to each other than to choanae; tongue cordiform, deeply notched posteriorly, free for approximately two-thirds its length; vocal sac opening on floor of mouth at corner; sac-like gular pouch,

front margin positioned near to level of center of orbit.

Tips of all four fingers expanded with circummarginal grooves; width of finger III disc slightly greater than width of phalanx, half diameter of tympanum; relative finger lengths  $I < II < IV < III$ ; ventral callous pad on fingers II, III, and IV from distal edge of proximal subarticular tubercle to base of disc; no movable flap of skin on preaxial side of fingers II and III; one subarticular tubercle on fingers I and II, two subarticular tubercles on fingers III and IV; one supernumerary tubercle proximal to proximal subarticular tubercle on fingers II, III, and IV; two palmar tubercles, oval, in contact; velvety nuptial pad on finger I, covering dorsal surface to level of distal edge of subarticular tubercle, covering medial surface to base of finger disc; forearm robust.

Tips of toes expanded, width of toe IV disc equal to width of finger III disc; toe III shorter than toe V; toes I, II, III, and V fully webbed to base of discs; toe IV fully webbed to distal subarticular tubercle with narrow extension to base of disc; movable flap of skin on preaxial side of toe I and postaxial side of V to level of proximal subarticular tubercle; elongate, oval inner metatarsal tubercle; round, small outer metatarsal tubercle.

Skin smooth on all surfaces except granular on posterior surface of thigh; no humeral gland; supratympanic fold from anterior margin of tympanic rim to near posterior rictal gland; weak glandular dorsolateral fold from rear of eye to near vent; two rictal glands, anterior gland continuous with upper lip.

Measurements (mm) of holotype: SVL 37.0; HDL 14.4; HDW 12.1; SNT 5.2; EYE 4.7; IOD 3.4; TMP 2.0; TEY 1.5; TIB 23.4; FEM 17.2; HND 10.1; FTL 18.8.

*Coloration of holotype in preservative*.—Dorsum dark blue-green, extending just below dorsolateral fold; brown and white network visible beneath blue-green dorsum; side of head dark brown from tip of snout to anterior one-third of flank, posterior two-thirds of flank light brown marbled with creamy-white, white patch at groin; lip stripe creamy-white; rictal glands yellow; dorsal surface of limbs light brown with narrow, diffuse dark brown crossbars, interspersed with small dark brown spots; posterior surface of thigh yellow with dark brown marbling, white near vent; venter cream with distinct yellow pigment on chin and outer margins of belly, brown mottling on underside of lower jaw, brown elongated markings on throat, gular pouch, chest, and

TABLE 2. MEASUREMENTS (MM) OF *Rana compotrix*, NEW SPECIES. Abbreviations defined in the text.

Measurement	Adult males; holotype and paratypes Laos	Adult female paratype Laos	Adult male paratypes Vietnam	Adult female paratypes Vietnam
	Range; Mean $\pm$ S.D. (n = 6)	FMNH 256503 (n = 1)	Range; Mean $\pm$ S.D. (n = 4)	ZISP A7364, 7366; Mean
SVL	31.4–37.0; 35.4 $\pm$ 1.7	56.7	37.8–42.6; 40.2 $\pm$ 2.3	56.9, 55.6; 56.2
HDL	12.3–14.6; 13.3 $\pm$ 0.9	20.1	13.9–14.3; 14.0 $\pm$ 0.2	19.0, 19.1; 19.1
HDW	10.1–12.1; 11.0 $\pm$ 0.6	18.2	12.2–13.3; 12.7 $\pm$ 0.4	17.5, 16.8; 17.2
SNT	4.9–5.9; 5.3 $\pm$ 0.3	8.2	5.3–5.7; 5.5 $\pm$ 0.2	7.8, 7.7; 7.8
EYE	4.5–5.0; 4.6 $\pm$ 0.2	6.9	5.2–5.6; 5.4 $\pm$ 0.2	7.1, 6.8; 7.0
IOD	3.2–3.8; 3.5 $\pm$ 0.2	5.4	3.7–4.2; 3.9 $\pm$ 0.2	6.0, 5.9; 6.0
TMP	1.8–2.5; 2.2 $\pm$ 0.2	3.1	2.4–2.6; 2.5 $\pm$ 0.1	2.9, 3.0; 3.0
TEY	1.0–1.7; 1.3 $\pm$ 0.2	1.8	1.3–1.4; 1.4 $\pm$ 0.1	2.1, 2.0; 2.1
TIB	17.9–23.4; 22.0 $\pm$ 1.6	35.2	23.0–24.3; 23.5 $\pm$ 0.6	33.0, 31.9; 32.4
FEM	15.2–17.5; 17.1 $\pm$ 1.0	26.7	20.7–22.9; 21.8 $\pm$ 1.0	29.1, 28.9; 29.0
HND	8.3–10.7; 10.0 $\pm$ 0.8	15.0	11.8–13.0; 12.4 $\pm$ 0.6	15.7, 15.9; 15.8
FTL	14.7–18.8; 17.2 $\pm$ 1.3	26.9	20.2–23.7; 21.7 $\pm$ 1.5	28.9, 27.7; 28.3
	Range; Median		Range; Median	Range; Median
HDL : HDW	1.10–1.29; 1.22	1.10	1.08–1.14; 1.10	1.09, 1.14; 1.11
SNT : HDL	0.36–0.45; 0.40	0.41	0.38–0.40; 0.39	0.40, 0.41; 0.41
TMP : EYE	0.41–0.51; 0.47	0.45	0.43–0.48; 0.46	0.41, 0.44; 0.42
EYE : SNT	0.79–0.94; 0.90	0.84	0.95–1.04; 0.98	0.88, 0.91; 0.90
TIB : SVL	0.57–0.66; 0.62	0.62	0.56–0.61; 0.58	0.57, 0.58; 0.58

outer margins of belly; dark brown axillary spot posterior to gular pouch; ventral surface of hindlimb mostly immaculate; nuptial pad white; outer metatarsal tubercle white; foot webbing gray with dark gray flecking, outer margin white.

*Variation.*—Measurements of paratypes summarized in Table 1. Vietnam males have larger SVL and FEM than Laos males; in Laos, SVL of males 55–65% SVL of females, in Vietnam SVL of males 66–77% SVL of females (Table 2). Supratympanic fold present only in holotype and one male paratype. Interorbital distance greater than width of upper eyelid in female. Width of finger III disc about equal to diameter of tympanum in female. Dorsum of female in preservative lighter in coloration than males; blue-green to yellowish-green. Ova in life and preservative uniformly yellow, without pigmented hemisphere, approximately 1–2 mm diameter.

*Coloration in life of paratypes.*—Dorsum and lateral color dependent on sex and time of day: nocturnal dorsal color in females light brown with dark brown speckling (dark green with dark brown speckling diurnally), nocturnal dorsal color in males light brown suffused with green (green, with or without brown speckling diurnally); side of head dark brown or black at night (reddish-brown diurnally), from tip of snout, diffusing posterior to axilla, continuing

as black streak below edge of dorsolateral fold (not visible diurnally in some males); bronze blotch in contact with upper lip at base of lores (light green in some males); white lip stripe from tip of snout to posterior of arm insertion (gold-white or yellow diurnally); upper one-fourth of iris gold, lower three-fourths black with metallic orange flecking; narrow gold stripe on edge of canthus from tip of snout along margin of upper eyelid continuing above edge of dorsolateral fold; flank brown anteriorly, diffusing to yellow posteriorly (flank almost entirely yellow in diurnal males; diffuses to pink in some diurnal females); red subcutaneous vascularization visible on flank of gravid females; dorsal surface of limbs grayish-brown or light brown with narrow, diffuse dark green crossbars (red-brown in diurnal males); underside of lower jaw, throat, chest, and belly white, with gray elongated markings on throat, gular pouch, chest, anterior half and outer margins of belly, sometimes with distinct yellow pigment on chin and outer margins of belly; dark brown axillary spot; ventral surface of forelimbs gray, ventral surface of hindlimbs yellow with dark brown speckling; nuptial pad gray; ventral surface of feet black, foot webbing black, outer margin yellow.

*Distribution and ecology.*—Paratypes of *R. compotrix* were observed to be in axillary amplexus in September (Vietnam) and November (Laos). In

Vietnam, calling males were found on rocks and bushes within the splash zone of a large cascade (height ca. 5 m), and amplexing pairs were found very close to the cascade, either on the ground or on wide leaves of *Araceae* plants. The amplexing pair from Laos (FMNH 256503–04) was found on a gravel bank on the edge of a stream pool. Other paratypes from Laos were collected at night in evergreen forest on stems and leaves of herbaceous plants, 1–2 m above the ground, within 4 m of stream banks. Tadpoles are unknown.

*Remarks.*—Stuart (1999:48) referred to Lao specimens of *R. compotrix* as *R. archotaphus*.

*Etymology.*—The specific epithet comes from the Latin *compotrix*, for a drinking partner, in reference to the splash zone breeding behavior of this species.

#### DISCUSSION

Higher-level taxonomy within the Southeast Asian members of the family Ranidae remains problematic, largely due to a lack of phylogenetic support for classifications (e.g., Emerson and Berrigan, 1993; Inger, 1996, 1999). Frogs morphologically similar to *R. archotaphus* have been placed in either the genus *Rana* or *Amolops*. *Rana* is a globally distributed, polyphyletic genus (Frost, unpubl., data online at <http://research.amnh.org/herpetology/amphibia/index.html>). *Amolops* is a South and Southeast Asian genus diagnosed by having tadpoles with a sharply defined abdominal sucker, no lateral glands, and fewer than three rows of labial teeth (Inger, 1966; Yang, 1991). Tadpoles are unknown in the new species, and there is currently no evidence to suggest that *Amolops* represents a monophyletic group. Consequently, we adopt the conservative approach of treating the three new species as members of the genus *Rana sensu lato*, pending a phylogenetic analysis that includes the new species. However, we compared the new species against all other Southeast Asian ranid species with which they might be confused, i.e., those having the character combination of SVL of females <70 mm, first finger shorter than the second, digit tips expanded with circummarginal grooves, dorsolateral folds, upper parts with smooth skin, males without humeral glands, and unpigmented eggs, regardless of their current generic allocation.

As efforts to assess the conservation status of amphibians continue (e.g., IUCN, Conservation International, and NatureServe., unpubl. data

online at: <http://www.globalamphibians.org/>), reliable data on species distributions become increasingly important. Morphological similarity in amphibian species complexes can lead workers to underestimate species diversity and overestimate the size of species ranges. Since the description of *R. archotaphus*, six other morphologically similar swift-water frogs from Southeast Asia have been described: *Amolops bellulus*, *R. cucae* n. sp., *R. compotrix* n. sp., *R. daorum*, *R. vitrea* n. sp., and *R. iriodes* (Liu et al., 2000; Bain et al., 2003; Bain and Nguyen, 2004). Additional comments on morphological characters of type specimens of *Amolops chunganensis*, *R. archotaphus*, *R. daorum*, and *R. iriodes* are provided below. The characters provided here were either not mentioned in the original description or were originally incorrectly interpreted.

In *Amolops chunganensis*, the pineal body is not visible in the holotype (AMNH 30479) and one other paratype, but it is a visible bump (and usually white) in all other paratypes. The front margin of the gular pouch is positioned near to the level of the center of the orbit. Only the outer three fingertips are more than twice the width of their phalanges, the first being less than two times the width of the phalange (evident in holotype and illustration in Pope, 1931:fig. 27). All fingers bear circummarginal grooves. The disc of finger III is less than one-half the tympanum diameter in the males and almost three-fourths the tympanum diameter in the female. The velvety nuptial pad on finger I covers the dorsal surface to the level of the distal edge of the subarticular tubercle and the medial surface to the base of finger disc. On the holotype, an outer metatarsal tubercle is absent on the left foot, but is low, weakly visible, and white on the right foot. Outer metatarsal tubercle condition is variable among paratypes: in male paratypes, they are either absent, weakly present, or strongly present; in the female paratype, there is a lightly colored outer metatarsal tubercle on the left foot, but no tubercle on the right foot. Whereas the holotype and most paratypes have a smooth dorsum, it is shagreened in some paratypes. The skin on the posterior portion of the thigh is slightly granular, continuing to the posterior-ventral surface in the holotype. In some paratype specimens, the posterior portion of the thigh is heavily granular. The flanks lack glandular spots. The holotype bears small white spinules on the lores, the sacrum, around the vent, on the metatarsus, and on the posterior extent of the dorsolateral folds. The pattern of spinules varies among the paratypes: some have spinules on the dorsolateral fold that extend to the middle level of the dorsum; some have spinules on the rectal

glands; a few have spinules on the posterior corner of the upper eyelid; and one specimen has spinules on the vocal sac. The lone female paratype has spinules on the rectal glands, a few on the rear of the upper lip adjacent to the rectal glands, the entire length of the dorsolateral folds, and around the vent. No specimens in the type series have spinules on the chest. The posterior portion of the thigh is banded, but without marbling. The venter is dusted with dark pigment, but without any large or irregular spots.

Specimens of *A. chunganensis* reported from the Hoang Lien Mountains of Vietnam (Ohler et al., 2000) should be compared with other *R. archotaphus*-like species (particularly *R. daorum* and *R. cucae*) to ensure that their identification is correct. Until that time, *A. chunganensis* should not be considered part of the fauna of Vietnam.

In *Rana archotaphus*, the holotype (FMNH 214074) has a visible pineal body. The first finger bears a weakly visible circummarginal groove. The front margin of the gular pouch is positioned near to the level of the center of the orbit. There is no movable skin flap on fingers II and III.

In *Rana daorum*, the pineal body is visible. The holotype (ROM 26381) has two very small vomerine teeth on the right ridge and four very small teeth on the left ridge. Some paratypes, as well as a series from Laos (see Material Examined), exhibit a few weak vomerine teeth without a ridge, but most of the paratypes lack both vomerine teeth and ridges. The front margin of the gular pouch is positioned near to the level of the center of the orbit. There is no external moveable flap on fingers II and III (contrary to Bain and Nguyen, 2004:16, who reported a “furrow” on the fingers). Only the outer three fingertips are more than twice the width of their phalanges, the first being less than two times the width of the phalange. Both sexes have white spinules (described as “granules” by Bain et al., 2003:39–40) in a single row on the dorsolateral folds and in a cluster on the temporal region, tympanic region, and posterior corner of the upper eyelid. The Laos specimens exhibit yellow on the outer margins of the lower jaw and belly. The holotype of *R. daorum* has a very low, indistinct outer metatarsal tubercle visible as a white spot. Two paratypes (ROM 26388, 26394) exhibit outer metatarsal tubercles, but they are absent in the remaining paratypes ( $n = 73$ ).

Bain et al. (2003:40) noted the presence of *R. daorum* in Hong Kong, based on a photograph of a “froglet of *Rana livida*” in Karsen et al. (1998). The photograph shows a small cascade frog with a glandular white dorsolateral fold. Although it is

possible that the photograph is of *R. daorum*, the diversity of green cascade ranids now known from the region warrants more caution in identification of these species. *Rana daorum* should not be treated as part of the fauna of Hong Kong until a voucher has been examined.

In *Rana iriodes*, the pineal body is visible. Only the outer three fingertips are more than twice the width of their phalanges, the first being less than two times the width of the phalange. The front margin of the gular pouch is positioned near to the level of the center of the orbit. An outer metatarsal tubercle is absent on the right foot of the holotype (AMNH 163925/IEBR 70), but is low, weakly visible, and white on the left foot (Bain and Nguyen, 2004:fig. 9). Outer metatarsal tubercles are absent on both male paratypes, but are weakly visible on the female paratype. The skin on the posterior portion of the thigh is slightly granular, continuing to the posterior-ventral surface.

#### MATERIAL EXAMINED

*Amolops chunganensis* (15). China, Fujian Province (as Fukien Province): AMNH 30479, male holotype; AMNH 30407, 30418, 30419, 30423, 30434, 30443, 30448, 30453, 30456, 30461, 30466, 30481, 30482, male paratypes; FMNH 24658 (field tag AMNH A30406), female paratype. *Rana archotaphus* (10). Thailand, Chiang Mai Province, Doi Inthanon National Park, Dawn Tak Them: FMNH 214074, male holotype; FMNH 187447–48, 214073, 214075–76, 216072–73, male paratypes; FMNH 214072, 216074, female paratypes. *R. daorum* (77). Vietnam, Lao Cai Province: ROM 26381, female holotype; ROM 38500, 38503, 38507, 38512, 38516, 38517, 38526, 38530, 38538, female paratypes; ROM 26382–26397, 38501, 38502, 38504–38506, 38508–38511, 38513–38515, 38518–38525, 38527–38529, 38532–38537, 38539, 38540, 38542–38543, 38546, 38548–38561, male paratypes; ROM 38547 subadult paratype. Laos, Huaphahn Province: FMNH 255353–55, males. *R. iriodes* (4). Vietnam, Ha Giang Province: AMNH 163925/IEBR 70, male holotype; AMNH 163924/IEBR 69, AMNH 163928, male paratypes; AMNH 163926, female paratype.

#### ACKNOWLEDGMENTS

This study was supported by funding from NASA (grant no. NAG5-12333, 2002–2005 to D. Frost), The John D. and Catherine T. MacArthur Foundation, the National Geographic Society (grant no. 6247-98 with H. Heatwole), and the Wildlife Conservation Society. The opportunity

for BLS to work in Laos was made possible by the Wildlife Conservation Society/Division of Forest Resource Conservation Cooperative Program. The Forestry Protection Department, Ministry of Agriculture and Rural Development (Lao Cai and Hanoi, Vietnam) permitted collection and export of specimens to the AMNH (permit no. 238-2004). The Ministry of Agriculture and Forestry (Vientiane, Laos) permitted export of specimens to the FMNH (permit no. MAF 0813). Collecting and handling of specimens in the field was in accordance with the AMNH Institutional Animal Care Needs Committee (live vertebrate research protocol no. 1998-12), and the Institutional Animal Care and Use Committee of the FMNH (protocol no. FMNH 02-3). We are grateful to E. Sterling and X. C. Le for support of work in Vietnam; Q. T. Nguyen, T. C. Ho, and V. K. Doan for logistical assistance in Vietnam; W. Robichaud, M. Hedemark, A. Johnson, and T. Hansel for logistical assistance in Laos; H. Heatwole and B. Thaovanseng for field assistance in Laos; M. Laverty, K. Koy, and M. De Jong for support and assistance; C. Raxworthy and L. Ford for facilitating the examination of specimens at the AMNH; H. Voris, A. Resetar, J. Ladonski, and J. Mui for facilitating the examination of specimens at the FMNH; R. Murphy, and R. MacCulloch for loaning specimens in their care and facilitating the examination of specimens at the ROM; S. Drasner for photographing specimens; and R. Inger and D. Frost for sharing their taxonomic opinions.

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