

A NEW CASCADE FROG (AMPHIBIA: RANIDAE) FROM LAOS AND VIETNAM

Bryan L. Stuart

Present address: Field Museum of Natural History, Department of Zoology, Division of Amphibians & Reptiles, 1400 S. Lake Shore Drive, Chicago, Illinois, USA 60605-2496; Email: bstuart@fieldmuseum.org

University of Illinois at Chicago, Department of Biological Sciences, 845 W. Taylor, Chicago, Illinois, USA 60607-7060

Wildlife Conservation Society, P.O. Box 6712, Vientiane, Laos

Nikolai L. Orlov

Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, St. Petersburg, 199034, Russia; azemiops@zin.ru

Tanya Chan-ard

National Science Museum, Thailand Natural History Museum, Technopolis, Klong 5, Klong Luang, Patumthani 12120, Thailand

ABSTRACT. – A new frog species of the family Ranidae is described from 44 specimens from the mountains of southern Laos and central Vietnam. *Rana khalam*, new species, is distinguished by having the first finger longer than the second; a distinct, round tympanum about one-half the diameter of the eye; a small, round outer metatarsal tubercle; a ventrolateral band of round tubercles with fine, whitish spinules in males; and darkly coloured tubercles, usually containing white asperities, on the rear of the back in females.

KEYWORDS. – Ranidae, *Rana*, *Huia*, *Amolops*, *Hylarana*, *Odorrana*, Laos, Vietnam.

INTRODUCTION

The pioneering work of Bourret (1942) on the frog fauna of Vietnam and Laos has been supplemented during the past decade by the discovery and description of new species (e.g. Inger & Kottelat, 1998; Lathrop et al., 1998a, b; Inger et al., 1999; Ohler et al., 2000; Orlov et al., 2001; Ziegler & Köhler, 2001; Bain et al., 2003; Ohler, 2003; Orlov et al., 2003; Matsui & Orlov, 2004; Orlov et al., 2004; Stuart & Heatwole, 2004). Recent taxonomic study of old and new collections by Bain et al. (2003) resulted in the description of six new species from Vietnam that are morphologically similar to the cascade frog *Rana livida* (Blyth, 1856). Here we report on another new cascade frog collected by us during herpetological surveys in the mountains of southern Laos in 1999 and central Vietnam in 2003.

MATERIALS AND METHODS

Specimens were caught in the field by hand, preserved in 10% buffered formalin, and later transferred to 70% ethanol. Tissue samples were taken from some individuals by preserving pieces of liver in 95% ethanol before the specimen was fixed in formalin. Specimens were deposited at the Field Museum of Natural History (FMNH), the Zoological Institute,

Russian Academy of Sciences (ZISP), and the Thailand Natural History Museum (THNHM). Comparative material was examined in the holdings of the Field Museum of Natural History and the Royal Ontario Museum (ROM).

Measurements largely follow those of Bain et al. (2003) and 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 the commissure of the jaws; HDW = head width at the commissure of the jaws; SNT = snout length from tip of snout to the anterior corner of the eye; EYE = eye diameter; IOD = interorbital distance; TMP = horizontal diameter of tympanum; TEY = tympanum-eye distance from anterior edge of tympanum to posterior corner of the eye; FEM = femur length from vent to knee; TIB = tibia length; FPL = length of finger III disc from the base of the pad to its tip; FPW = width of finger III disc at the widest part of the pad; TPL = length of toe IV disc; TPW = width of toe IV disc.

TAXONOMY

Rana khalam, new species
(Figs. 1-4)

Material examined. – Holotype: FMNH 258172, adult male, on a

leaf of an herbaceous plant along a small rocky stream in hilly wet evergreen forest in Xe Sap National Biodiversity Conservation Area, Kaleum District, Xe Kong Province, Laos, near 16°04'10"N 106°58'45"E between 1280-1500 m elevation, coll. B. L. Stuart, 05 July 1999.

Paratypes: FMNH 258173-75, 258224, 258226-27, 258457, 258459-60, nine males; FMNH 258108, 258158, 258455-56, 258458, 258461, 258587, seven females, type locality but from 1100-1500 m elevation, coll. B. L. Stuart, 05-09 July 1999. FMNH 262572-73, THNHM 00219-23, 00225-28, eleven males; FMNH 262574-75, THNHM 00224, 00229, four females, near Ban Beehi Village, Xe Sap National Biodiversity Conservation Area, Samoy District, Saravane Province, Laos, 16°08'40"N 106°56'50"E between 1200-1600 m elevation, coll. T. Chan-ard, 27 February-03 March 1999. ZISP 7236-40, five males, ZISP 7241-44, four females, Bach Ma National Park, Thua Thien-Hue Province, Hai Van mountain range, Vietnam, 16°10'33"N, 107°48'23"E, 1300-1400 m elevation, coll. N. L. Orlov, October 2003. ZISP 7245-47, three males, Ba Na National Park, Danang Province, Hai Van mountain range, Vietnam, 16°08'15"N, 107°55'47"E, 1400-1500 m elevation, coll. N. L. Orlov, October 2003.

Comparative material examined: *Rana archotaphus* FMNH 214074, holotype, male, Chiang Mai Province, Thailand; FMNH 187447-48, 214073, 214075-76, 216072-73, paratypes, males, Chiang Mai Province, Thailand; FMNH 214072, 216074, paratypes, females, Chiang Mai Province, Thailand. *Rana daorum* ROM 38501, paratype, male, Lao Cai Province, Vietnam; ROM 38503, paratype, female, Lao Cai Province, Vietnam; FMNH 255353-55, males, Huaphahn Province, Laos. *Huia nasica* FMNH 254277, female, Vinh Phu Province, Vietnam; FMNH 254278, male, Vinh Phu Province, Vietnam; FMNH 255399, female, Huaphahn Province; FMNH 256491 female, Khammouan Province, Laos; FMNH 256470-78, males, Khammouan Province, Laos.

Diagnosis. – A medium-sized ranid frog having all fingers expanded into round discs with circummarginal grooves; first finger longer than the second; distinct, round, tympanum about one-half the diameter of the eye, not depressed relative to skin of temporal region; no supratympanic fold; small tubercles in the temporal region; males with gular pouches appearing as skin folds at corners of throat; males without humeral glands; an oval inner and small, round outer metatarsal tubercle; a ventrolateral band of round tubercles with fine, whitish spinules in males; dorsal surface of rear of back with scattered, darkly coloured tubercles, usually containing white asperities, in females; ova in preservative yellowish with small, dark crown.

Description of Holotype. – Habitus moderately slender; head narrow, about equal in length and width; snout very slightly obtusely pointed, projecting beyond lower jaw, round in profile, not depressed; nostril lateral, about mid-way between eye and tip of snout; canthus distinct, slightly constricted behind nostrils; lores concave and oblique; eye diameter less than snout length; interorbital distance equal to width of upper eyelid; distinct, round tympanum about one-half the diameter of the eye, not depressed relative to skin of temporal region, tympanic rim elevated relative to tympanum; vomerine teeth

in oblique groups slightly closer to choanae than to each other; vocal sac opening at rear of mouth; gular pouches appearing as small, wrinkled, skin folds at corners of throat.

Tips of all four fingers expanded, about 1.5 to 2 times the width of phalanges, with circummarginal grooves, width of finger III disc about half the diameter of tympanum; relative finger lengths $II < I < IV < III$; one subarticular tubercle on finger II, two subarticular tubercles on fingers III and IV; one supernumerary tubercle proximal to subarticular tubercle on fingers II, III, and IV; palmar tubercle at base of fingers II, III, and IV; no humeral gland; velvety nuptial pad covering the medial and dorsal surface of the first finger from its base to the base of the finger disc, with a distinct constriction in the nuptial pad at the base of the first phalanx.

Tips of toes expanded, width of toe IV disc equal to width of finger III disc; toe III equal in length to 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; an oval inner and small, round outer metatarsal tubercle.

Skin smooth on dorsum, sides and venter; no dorsolateral fold; ventrolateral band of round tubercles with fine, whitish spinules; posterior surface of thighs granular.

Dorsal surface dark green in life; margin of lip brownish with some dark spots; canthus and temporal region dark; sides dark, becoming ivory at ventrolateral band of round tubercles; venter ivory, with brown pigmentation on throat, chest, underside of forearm, anterior half of abdomen, and marginal areas of underside of legs; rear of thigh dark with whitish patch below vent; limbs with dark crossbars.

Measurements (mm) of holotype: SVL 42.0; HDL 14.0; HDW 13.2; SNT 6.0; EYE 5.0; IOD 3.8; TMP 2.5; TEY 1.3; FEM 20.5; TIB 23.9; FPL 1.7; FPW 1.4; TPL 1.5; TPW 1.4; HDL:HDW 1.06; SNT:HDL 0.43; TMP:EYE 0.50; TIB:SVL 0.57. Measurements including other specimens summarized in Table 1.

Variation. – Skin finely granular dorsally and dorsolaterally in some specimens; weak dorsolateral fold present in some specimens; outer metatarsal tubercle oval rather than round in some specimens; interorbital distance slightly wider than width of upper eyelid in females; width of finger III disc about three-fourths the tympanum diameter in females; ventrolateral band of round tubercles sometimes present in females but without fine, whitish spinules; dorsal surface of rear of back in females with scattered, darkly coloured tubercles, usually containing white asperities; ovulated ova in preservative yellowish with small, dark crown.

Colouration in life highly variable, with dorsal surfaces dark green, dark greenish-brown, or brown, with few or many scattered dark spots. Females usually with more brown and with more expressed dorsal spotting than males. Both sexes sometimes with green toe webbing. Both sexes much paler in colouration at night than day, sometimes with dorsum and sides fading to yellow or yellowish-green at night.

Table 1. Measurements of *Rana khalam*, new species. Abbreviations defined in text.

Measurements	MALES	FEMALES
	<i>Range; Mean ± S.D. (N=29)</i>	<i>Range; Mean ± S.D. (N=15)</i>
SVL	39.0 – 46.7; 42.5 ± 1.8	53.4 – 63.3; 59.8 ± 2.8
HDL	12.5 – 16.0; 14.4 ± 0.8	18.5 – 22.1; 20.5 ± 0.9
HDW	12.5 – 14.3; 13.5 ± 0.6	18.5 – 23.1; 20.6 ± 1.1
SNT	5.5 – 6.8; 6.3 ± 0.3	7.7 – 9.5; 8.7 ± 0.5
EYE	4.8 – 6.1; 5.3 ± 0.3	6.2 – 8.0; 7.0 ± 0.5
IOD	3.4 – 4.5; 3.9 ± 0.3	5.1 – 6.3; 5.7 ± 0.3
TMP	2.5 – 3.0; 2.8 ± 0.1	3.1 – 4.2; 3.7 ± 0.3
TEY	1.0 – 1.5; 1.3 ± 0.2	2.0 – 2.8; 2.4 ± 0.2
FEM	20.1 – 23.2; 21.7 ± 0.8	29.0 – 33.8; 32.0 ± 1.6
TIB	23.2 – 25.8; 24.3 ± 0.7	33.8 – 39.0; 36.1 ± 1.4
FPL	1.2 – 2.0; 1.7 ± 0.2	1.8 – 3.2; 2.6 ± 0.4
FPW	1.1 – 1.8; 1.4 ± 0.2	1.6 – 3.0; 2.5 ± 0.4
TPL	1.2 – 1.8; 1.5 ± 0.2	1.8 – 2.9; 2.3 ± 0.3
TPW	0.9 – 1.5; 1.2 ± 0.2	1.5 – 2.5; 2.1 ± 0.3
	<i>Range; Median (N=29)</i>	<i>Range; Median (N=15)</i>
HDL:HDW	0.96 – 1.15; 1.07	0.94 – 1.07; 0.99
SNT:HDL	0.40 – 0.51; 0.44	0.40 – 0.45; 0.42
TMP:EYE	0.44 – 0.60; 0.53	0.41 – 0.63; 0.53
TIB:SVL	0.51 – 0.61; 0.57	0.55 – 0.66; 0.60

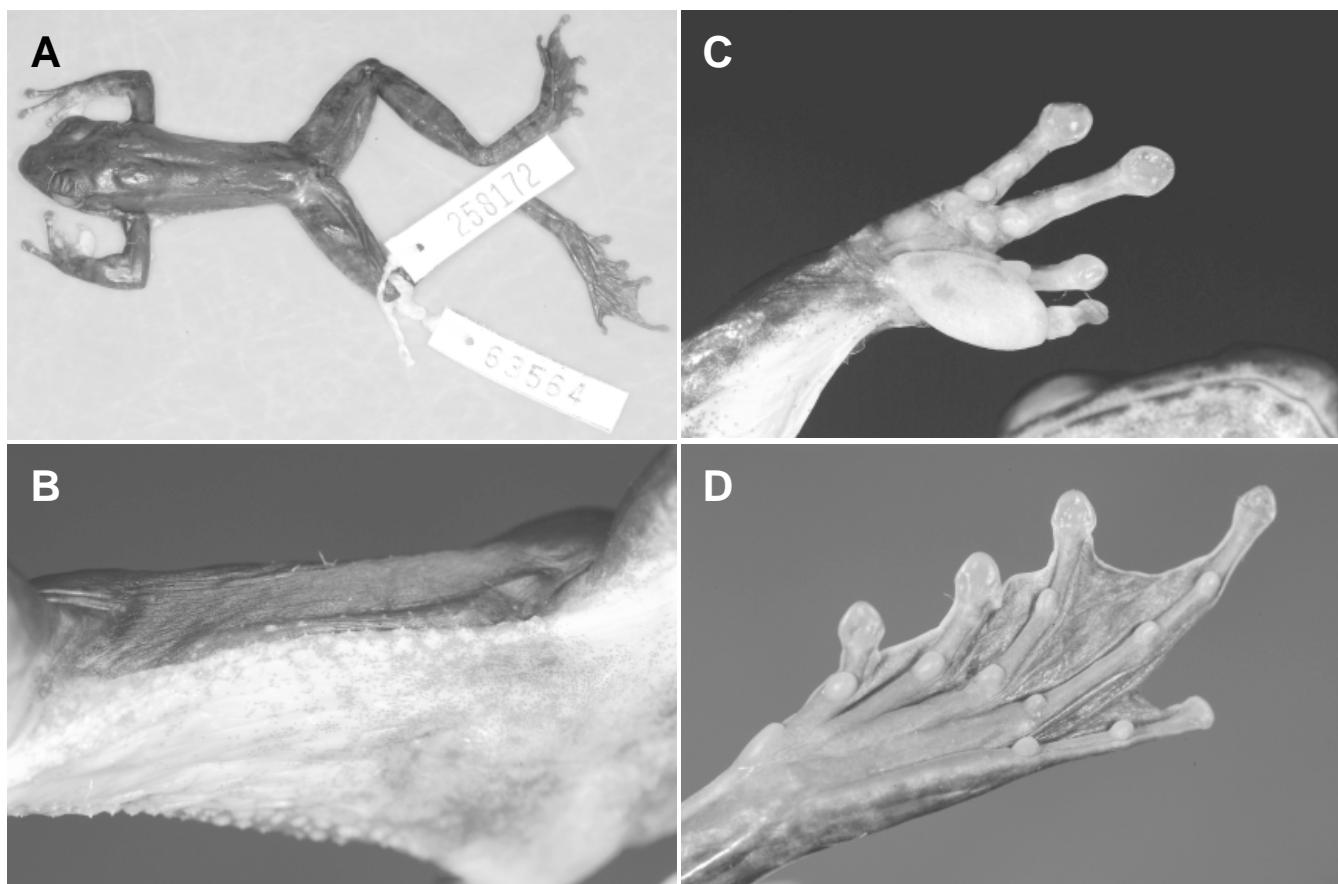


Fig. 1. *Rana khalam*, new species, male holotype (FMNH 258172) in preservative. A. dorsal view, B. ventrolateral surface showing band of round tubercles with fine, whitish spinules, C. palmar view of right hand, D. plantar view of left foot.

Etymology. – The word “khalam” (spelled phonetically) means taboo in the Lao language. Some ethnic hill tribe people living near the type locality believed it was “khalam” to sleep in the forest, and warned the collecting team that doing so would cause a bloody nose.

Distribution and ecology. – *Rana khalam* is known from Xe Sap National Biodiversity Conservation Area in Xe Kong and Saravane Provinces, southern Laos; Bach Ma National Park in Thua Thien-Hue Province, central Vietnam; and Ba Na National Park, Danang Province, central Vietnam (Fig. 5). Specimens were found along small, steep, rocky streams in hilly wet evergreen forest from 1100-1600 m asl (Fig. 6). In July in Laos, all specimens were collected at night perched on rocks, tree roots, and stems and leaves of herbaceous plants less than 7 m from streams. In October in Vietnam, males were calling at night while perched on rocks and branches of bushes above or near streams, and females were on the ground 3-5 m from streams.



Fig. 2. Male paratype of *Rana khalam*, new species, in life from Xe Sap National Biodiversity Conservation Area, Xe Kong Province, Laos.



Fig. 3. Female paratype of *Rana khalam*, new species, in life from Bach Ma National Park, Thua Thien-Hue Province, Vietnam.

Remarks. – Higher level taxonomy within the large family Ranidae remains problematic and uncertain (e.g. Dubois, 1992; Inger, 1996; Dubois, 1999; Chen et al., in press). Cascade frogs have been variously placed in the genera *Rana*, *Amolops*, *Huia*, *Meristogenys*, *Hylarana*, and *Odorrana* (Bain et al., 2003). Dubois (1992) proposed a generic classification for the Ranidae based on phenetic comparisons, but this classification has received spirited criticism (Inger, 1996), and a recent phylogenetic analysis of Asian ranids has found only partial support for Dubois’ classification (Chen et al., in press). We adopt the conservative approach of treating *khalam* as a member of the genus *Rana* sensu lato pending a phylogenetic analysis that includes this new species.

A large number of other Southeast Asian ranids have grooved, expanded finger discs (Yang, 1991; Bain et al., 2003; Orlov et al., 2003), but only *R. khalam* bears the combination of having an outer metatarsal tubercle, the first finger longer than the second, dorsolateral fold weak or absent, and males with a ventrolateral band of round tubercles with fine, whitish spinules. *Rana khalam* superficially most closely resembles *Huia nasica* (Boulenger, 1903), *R. archotaphus* Inger & Chanard, 1997, *R. daorum* Bain, Lathrop, Murphy, Orlov, & Ho, 2003, *R. trankieni* Orlov, Le & Ho, 2003, and *R. iriodes* Bain & Nguyen, 2004. *Rana khalam* differs from *H. nasica* by having gular pouches appearing as skin folds at corners of throat (gular pouches sac-like in *nasica*), having a ventrolateral band of round tubercles containing fine whitish spinules in males (male *nasica* with whitish spinules scattered ventrally near to the groin and in a small, ventrolateral cluster near to the insertion of the forearm), having small white



Fig. 4. Male paratype (ZISP 7245) of *Rana khalam*, new species, in life from Ba Na National Park, Danang Province, Vietnam, exhibiting pale night colouration.

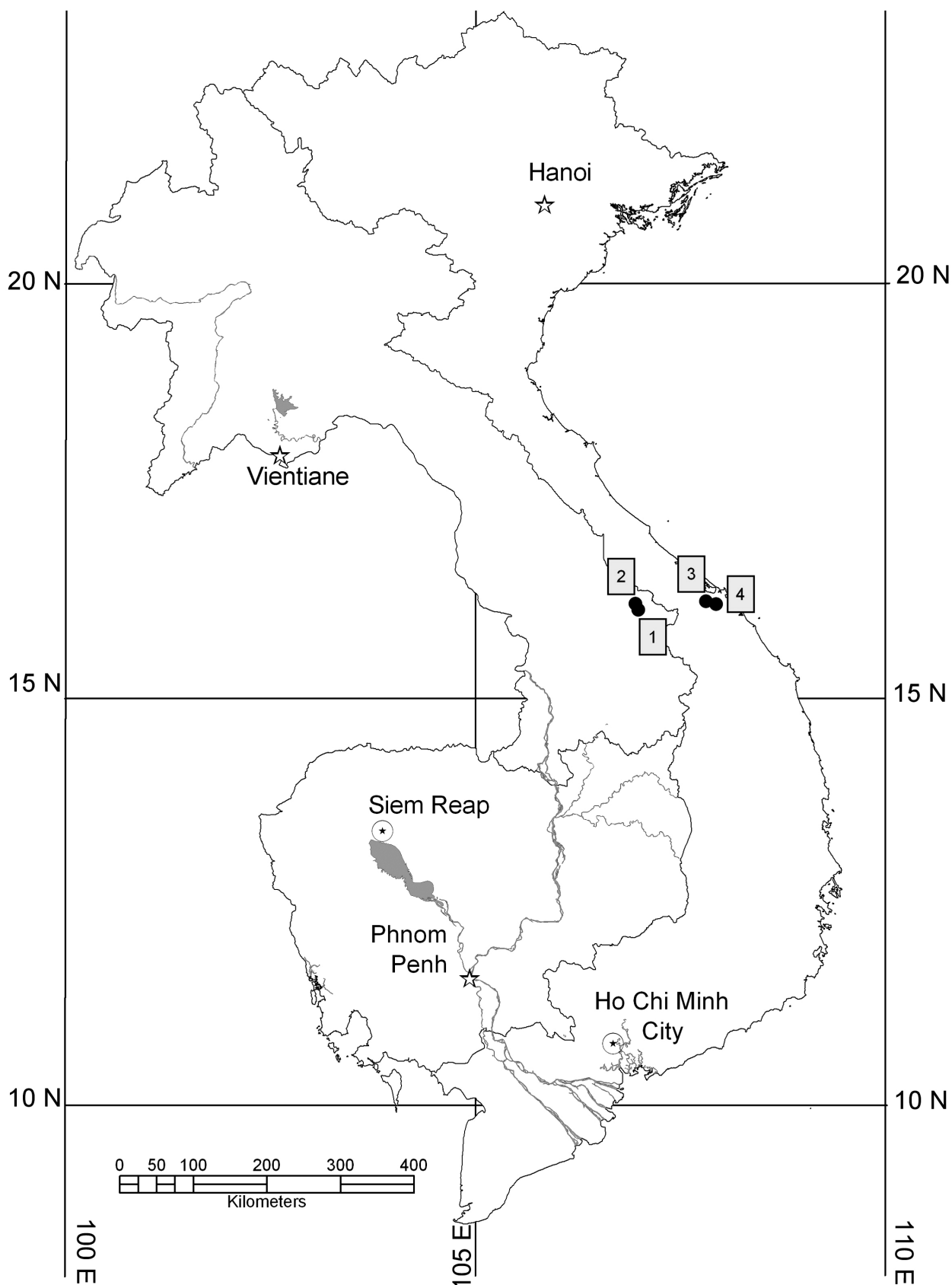


Fig. 5. Map illustrating the collecting localities of *Rana khalam*, new species, 1 = Xe Sap National Biodiversity Conservation Area, Kaleum District, Xe Kong Province, Laos, 16°04'10"N 106°58'45"E; 2 = Xe Sap National Biodiversity Conservation Area, Samoy District, Saravane Province, 16°08'40"N 106°56'50"E; 3 = Bach Ma National Park, Thua Thien-Hue Province, Hai Van mountain range, Vietnam, 16°10'33"N 107°48'23"E; 4 = Ba Na National Park, Danang Province, Hai Van mountain range, Vietnam, 16°08'15"N 107°55'47"E.

asperities on the rear of back of females only (on both sexes in *nasica*), and by having smaller females (female *nasica* to 79.1 mm). *Rana khalam* differs from *R. archotaphus* by having the first finger longer than the second (first finger shorter than the second in *archotaphus*), having an eye diameter less than the length of the snout (eye diameter equal to or longer than the length of the snout in *archotaphus*), having a pigmented upper lip (upper lip mostly white in *archotaphus*), having gular pouches appearing as skin folds at corners of throat (gular pouches large and sac-like in *archotaphus*), having males with a ventrolateral band of round tubercles containing fine whitish spinules (absent in *archotaphus*), and having females with scattered, darkly coloured tubercles, usually containing white asperities on the rear of back (absent in *archotaphus*). *Rana khalam* differs from *R. daorum* by having the first finger longer than the second (first finger shorter than the second in *daorum*), lacking small white asperities on the dorsolateral fold (present in *daorum*), and lacking at least one large white or yellow glandular spot on the flanks (present in *daorum*). *Rana khalam* differs from *R. trunkieni*, of which only males are known, by having a ventrolateral band of round tubercles containing fine whitish spinules in males (absent in *trankieni*) and by having smaller males (male *trankieni* to 77.0 mm). *Rana khalam* differs from *R. iriodes* by having males with a ventrolateral band of round tubercles containing fine whitish spinules (absent in *iriodes*), lacking gold or orange-red weak dorsolateral folds (present in *iriodes*), and lacking a white glandular spot on the flanks (present in *iriodes*).

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Fig. 6. Habitat of *Rana khalam*, new species, in Bach Ma National Park, Thua Thien-Hue Province, Vietnam.

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