

## *Trimeresurus (Popeia) phuketensis*, A NEW PITVIPER (SQUAMATA: VIPERIDAE) FROM PHUKET ISLAND, SOUTHWESTERN THAILAND

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A new species of pitviper, *Trimeresurus (Popeia) phuketensis* sp. nov., is described from Phuket Island, southwestern Thailand. Males of the new species are most similar to males of *Trimeresurus (P.) fucatus* of the Thai-Malay Peninsula and of *T. (P.) buniana* of Tioman Island in color pattern, but male pattern is however clearly distinct, and females of the new species show a bicolor postorbital streak and a bicolor ventrolateral stripe that are unique among all *Popeia* species.

**Keywords:** *Trimeresurus phuketensis*; *Popeia*; new species; Phuket Island; Thailand.

### INTRODUCTION

During a series of herpetological inventory surveys on Phuket Island between June 2008 and October 2009, we observed nine conspecific pitvipers of the genus *Trimeresurus* that we could not readily identify. We hence collected three adult males and two adult females for breeding in captivity, and recorded ecological and morphological observations. In March 2009, eight snakes were born in captivity and kept in terrariums. After some individuals of the first (wild-caught) and second generations died, their morphological examination unambiguously confirmed that these had all the diagnostic character states of the subgenus *Popeia* Malhotra and Thorpe, 2004, and moreover that they could not be assigned to any currently recognized species in this subgenus. We consequently describe it hereafter as new.

### MATERIAL AND METHODS

The present description is based on the morphological examination of 10 specimens (2 adult males, 3 juve-

nile males, one adult female and 4 juvenile females), collected at the type locality or captive-bred from individuals collected at the type locality. We used standard morphological and morphometrical characters, following the recent revision by Vogel et al. (2004) of the *Trimeresurus popeiorum* group (i.e., the subgenus *Popeia*). Measurements on the body and tail were taken to the nearest millimeter. Other measurements were taken with a caliper to the nearest 0.01 mm. Ventral scales were counted according to Dowling (1951), and prefrontal numbers are thus given separately. The terminal pointed scale of the tail is not included in the subcaudals. The number of midbody scale rows is counted at the level of the ventral plate corresponding to half of the total number of ventrals. Paired meristical characters are given in the right/left order.

**Morphometrical abbreviations:** DEL, distance between the lower eye margin and the edge of the lip; DSR, dorsal scale rows; HL, head length, measured from the posterior margin of the mandible to the tip of the rostrum; HW, head width, measured from the widest part of the head posterior to eye; SVL, snout-vent length; TaL, tail length; TL, total length; VED, vertical eye diameter. Meristical characters abbreviations, CEP, cephalic scales (scales on a line between the middle of supraoculars); C3SL, number of scales between the 3<sup>rd</sup> supralabial and the subocular; C5SL, number of scales between the 5<sup>th</sup> supralabial and the subocular; IL, infralabials; MSR, number of scale rows at midbody; SC, subcaudals; SL, supralabials; VEN, ventral scales.

**Museum acronyms:** Chulalongkorn University Museum of Zoology, Herpetological Section, Bangkok

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Fig. 1. Live male holotype of *Trimeresurus (Popeia) phuketensis* sp. nov. (photo by M. Sumontha).

(CUMZ R); Khorat Zoo Museum, Nakhonratchasima (KZM); Kasetsart University Museum of Zoology (KUMZ Rep); Queen Saovabha Memorial Institute, Thai Red Cross Society, Bangkok (QSMI); Prince of Songkhla University Zoological Collection, Reptile Section, Songkhla (PSUZC-RT); Montri Sumontha's Private Collection, Ranong (MS); Thailand Natural History Museum, National Science Museum, Technopolis, Pathum Thani (THNHM).

## TAXONOMY

### *Trimeresurus (Popeia) phuketensis* sp. nov.

Figs. 1 – 7

**Holotype.** THNHM 15905 [formerly MS 390], adult male from Ban Bangrong, Thalang District, Phuket Island, Phuket Province, southwestern Thailand. Collected by Kirati Kunya on 5 October 2009.

**Paratypes** (9). CUMZ R 2009.6.24-7 (formerly MS 397), adult male, 11 June 2008, same locality as holotype. PSUZC-RT 2010.51 (formerly MS 405), juvenile

male, and KZM 005, adult female, 5 October 2009, same locality as holotype. QSMI 1161 (formerly MS 375), KZM 004 (formerly MS 418), juvenile males; THNHM 15906 (formerly MS 155), CUMZ R 2009.6.24-8 (formerly MS 158), KUMZ Rep-000317 (formerly MS 392), QSMI 1162 (formerly MS 419), juvenile females; all captive born on 5 March 2009 from a pair of snakes collected in June 2008 from the same locality as holotype.

**Diagnosis.** A species of the genus *Trimeresurus* Lacepède, 1804, subgenus *Popeia* Malhotra and Thorpe, 2004, characterized by (1) hemipenes long, reaching *in situ* at least the 25<sup>th</sup> SC, without spines; (2) 1<sup>st</sup> supralabial distinct from nasal; (3) 23 – 25 DSR around neck about one HL behind head; (4) 21 MSR, keeled; (5) overall coloration green with reddish-brown crossbands in both males and females; (6) presence of a postocular streak, reddish brown in its wide upper part and white in its narrow lower part, in both males and females; (7) thin, white (above) and red (below) ventrolateral stripe in males, light green (above) and red (below) ventrolateral stripe in females; (8) rather long tail with a ratio TaL/TL between 0.19 and 0.23 in males and between 0.17 and 0.18 in



Fig. 2. General dorsal view of the preserved holotype of *Trimeresurus (Popeia) phuketensis* sp. nov. (photo by M. Sumontha).

females; (9) occipital scales smooth or weakly keeled; and (10) temporal scales large, as large as posterior temporals.

**Etymology.** The specific epithet is an adjective in reference to the type locality, Phuket Island.

**Suggested common names:** Phuket Pitviper (English), Ngoo Kheeow Hang Mai Phuket (Thai); Trimérésure de Phuket (French); Phuket Bambusotter (German).

**Description of holotype** (Figs. 1–4). Body long and thin, SVL 495 mm; head triangular and elongate, head length 26.0 mm; head width 19.5 mm; HW/HL 0.75, clearly distinct from the neck; distance between nostrils 5.65 mm; distance between preoculars 9.9 mm; distance between posterior margin of the mandibles 16.8 mm; snout elongate, 0.31 of HL, 2.15 times as long as diameter of eye, obliquely truncated when seen from lateral side, flattened and rounded when seen from above, with a very distinct *canthus rostralis*. Rostral slightly visible from above, triangular; nasals subtriangular, undivided, with nostril in their middle; one pair of enlarged, nearly subrectangular and straight internasals; 3/3 canthal scales bordering the *canthus rostralis*, between the internasal and corresponding supraocular, as wide as adjacent snout scales; 1 triangular loreal between upper preocular and nasal; two upper preoculars above the loreal pit, elongated and in contact with the loreal; lower



Fig. 3. Lateral head view of the holotype of *Trimeresurus (Popeia) phuketensis* sp. nov. (photo by M. Sumontha).

preocular forming the lower margin of the loreal pit; 3/2 postoculars; 1 entire, long and narrow supraocular on each side, about 3.60/3.12 times as long as wide; supraoculars indented on their inner margin by the upper head scales; scales on upper snout surface smooth, subimbricated, rhomboid, enlarged, with 4 snout scales on a line between the scale separating the internasals and a line connecting the anterior margins of eyes; cephalic scales small, much irregular, subimbricated, smooth or feebly



Fig. 4. General ventral view of the preserved holotype of *Trimeresurus (Popeia) phuketensis* sp. nov. (photo by M. Sumontha).

keeled on upper head surface; 12 CEP in a line between supraoculars; occipital scales flat, keeled; temporals large, as large as or larger than posterior temporals, subequal, in 2 or 3 rows, smooth; one thin, elongated, crescent-like subocular; 11/11 supralabials; 1<sup>st</sup> supralabial triangular, short, totally separated from the corresponding nasal; 2<sup>nd</sup> supralabial high, forming the anterior border of the loreal pit, in contact with nasal; 3<sup>rd</sup> supralabial larger than other supralabials, pentagonal, high and long, 1.44 times as long as high, in contact with the subocular; 4<sup>th</sup> supralabial short, longer than high, 0.84 time as high as 3<sup>rd</sup> one, in contact with subocular; 5<sup>th</sup> and posterior supralabials smaller than 4<sup>th</sup> one, 5<sup>th</sup> supralabial separated from the subocular by one scale on both sides, others in contact with the first row of temporals; 13/13 infralabials, those of the first pair in contact with each other, the first three pairs in contact with the chin shields; 6/5 rows of smooth gular scales; chin shields regularly arranged. Body scalation: 23 dorsal scales one head length behind head; 21 dorsal scales at midbody; 15 dorsal scales one head length anterior to vent; dorsal scales rhomboid, sharply keeled, except 1<sup>st</sup> row which is smooth; 2 pre-ventral scales; 170 ventral scales; 77 subcaudal scales, paired; anal shield entire. Eyes large, with VED/DEL ratio 1.22; tail slightly compressed, rather long and tapering, TaL 145 mm; TaL/TL 0.23. Tail distinctly prehensile.

**Coloration in life.** The ground color in life is leaf green with 78 transverse, zigzagging, reddish-brown bands, between 3<sup>rd</sup> DSR of each side, 1 or 2 scale rows width, apart on the body and 38 bands on the brownish tail; mid-dorsal bluish white spots present between the maroon bands (Fig. 1). Head green with maroon markings, paler green on the supralabials. The iris is copper. A bicolor postorbital streak, upper part reddish brown, lower one narrow whitish, extends from the posterior margin of the eye to the ventrolateral stripe, with an inversion zone of the maroon and whitish colors between the posterior margin of the mandible and the anteriormost point of the ventrolateral stripe. A ventrolateral, white stripe, formed by white markings on the lower part of each scale of the 2<sup>nd</sup> DSR and white spots on the postero-dorsal part of each scale of the 1<sup>st</sup> DSR, runs the entire length of the body and is bordered ventrally by a reddish stripe on the 1<sup>st</sup> DSR and on the lateral tip of ventral scales, that runs the entire length of the body. Venter light green, paler than dorsum background color. The tail is banded in two shades of brown with the ground color being the lighter of the two, scattered with white spots on its ventrolateral sides.

In preservative (Figs. 2 – 4), the background color is olive green, alternating with dark brown bands. Head surface darker than body and indistinct marking. The tail

surface is basically the same color as the dorsum, barely mottled with faint rusty-brown near its tip.

**Variation.** Meristical and morphometrical characters for the type series are provided in Table 1. Live adult female and juvenile color patterns are shown on Figs. 5 – 7.

**Description of hemipenes.** From THNHM 15905 (holotype, hemipenes partly everted): hemipenes are bilobate, long and slender, reaching the 25<sup>th</sup> SC, rounded at their extremity. The area near the sulcus spermaticus is strongly calyculate. The shallow sulcus spermaticus divides at the base of the organ.

**Distribution.** The new species was only found at the type locality and is probably limited to mature secondary and primary forest areas of Phuket Island. Extensive field research in comparable forest habitats in Phang-Nga Province (see Grossmann and Tillack 2001a, 2001b; Pauwels et al. 2000, 2002), on the mainland facing Phuket Island, did not reveal any *Trimeresurus (Popeia) phuketensis*, but several other viperids, including the closely related *T. (P.) fucatus*.

**Biological notes.** *Trimeresurus (Popeia) phuketensis* sp. nov. is nocturnal and is found mostly on shrubs and undergrowth up to 3 m above the ground in mature secondary forests. It was found perched on *Streblus ilicifolius* (Vidal) Corner (Moraceae), Rattan palms — *Calamus longisetus* Griff. and *Daemonorops* spp. (Arecaceae), *Rinorea* sp. (Violaceae), *Hoya* spp. (Asclepiadaceae), Bamboo — *Gigantochloa compressa* Parkinson (Gramineae), *Syzygium* spp. (Myrtaceae), etc. and also on fallen logs. Its biotope is shown on Fig. 8. This species spends the daytime resting in live vegetation or on dead sticks. In the wild it hunts at night and forages on vegetation, but occasionally also on the forest floor. Captive individuals accepted frogs [Dicroglossidae: *Fejervarya limnocharis* (Gravenhorst, 1829), *Ingerana tasanai* (Smith, 1921), *Limnonectes hascheanus* (Stoliczka, 1870), *Occidozyga martensii* (Peters, 1867); Rhacophoridae: *Polypedates leucomystax* (Gravenhorst, 1829)], mice, rats, bats and geckos [Gekkonidae: *Hemidactylus frenatus* Duméril et Bibron, 1836 and *H. platyurus* (Schneider, 1792)]. When approached, this species shows some aggressiveness, comparable to that of *Trimeresurus (Popeia) fucatus*. It sometimes strikes when it gets torch light towards its face. It seems locally common. Two captive females produced eight and nine offspring, respectively; juveniles shown on Figs. 6 – 7 are from the adult female paratype KZM 005.

TABLE 1. Meristical and Morphometrical Characters for the Type Series of *Trimeresurus (Popeia) phuketensis*

Collection number	Sex	SVL, mm	TaL, mm	TaL/TL	Postoc. streak	Lateral stripe	Transverse bands at midbody	Ventrolateral line on tail	VEN	SC	SL	CEP	IL	C3SL	C5SL
THNHM 15905	M	495.0	145.0	0.23	Red wide, white narrow	White and red distinct	Red wider than green, entire dorsolateral	Absent	170	77	11/11	12	13/13	0/0	1/1
CUMZR 2009.6.24-7	M	482.6	144.6	0.23	Red wide, white narrow	White and red distinct	Red wider than green with black posterior edge, entire dorsolateral	Absent	166	76	11/12	11	12/12	0/0	1/1
PSUZC-RT 2010.51	M (juv.)	324.9	77.7	0.19	Red wide, white narrow	White and red distinct	Red wider than green with black posterior edge, entire dorsolateral	Absent	170	76	11/11	12	12/12	0/0	1/1
QSMI 1161	M (juv.)	257.0	64.0	0.20	Red wide, white narrow	White and red distinct	Red wider than green with black posterior edge, entire dorsolateral	Absent	172	77	12/11	9	13/12	0/0	1/1
KZM 004	M (juv.)	151.5	41.2	0.21	Red wide, white narrow	White and red distinct	Red wider than green with black posterior edge, entire dorsolateral	Absent	169	79	11/11	11	12/13	0/0	1/1
KZM 005	F	614.7	133.7	0.18	Red wide, white narrow	White and red narrow	Red wider than green, distinct on dorsum	Absent	163	63	11/10	12	11/11	0/0	2/1
THNHM 15906	F (juv.)	160.0	33.0	0.17	Red wide, white narrow	White and red narrow	Red wider than green, distinct on dorsum	Absent	172	65	11/11	12	13/13	0/0	1/1
CUMZR 2009.6.24-7	F (juv.)	232.6	46.8	0.17	Red wide, white narrow	White and red narrow	Red wider than green, distinct on dorsum	Absent	165	63	11/12	11	13/14	0/0	1/1
KUMZ Rep 000317	F (juv.)	171.7	34.7	0.17	Red wide, white narrow	White and red narrow	Red wider than green, distinct on dorsum	Absent	167	65	11/11	12	13/13	0/0	1/1
QSMI 1162	F (juv.)	142.6	31.6	0.18	Red wide, white narrow	White and red narrow	Red wider than green, distinct on dorsum	Absent	166	64	11/11	11	14/13	0/0	1/1



Fig. 5. Live female paratype (KZM005) of *Trimeresurus (Popeia) phuketensis* sp. nov. (photo by K. Kunya).



Fig. 6. Live juvenile male *Trimeresurus (Popeia) phuketensis* sp. nov. from the type locality (not preserved) (photo by K. Kunya).

## DISCUSSION

Malhotra and Thorpe (2004) proposed a splitting of the genus *Trimeresurus auctorum* into several genera, based on hemipenial and molecular data. The long and

slender, bilobate, smooth hemipenes of the new species unambiguously allocate it to the *Trimeresurus popeiorum*'s species group, named the genus *Popeia* of Malhotra and Thorpe (2004). David et al. (2004), based on morphological characters, included five species in the



**Fig. 7.** Live juvenile female *Trimeresurus (Popeia) phuketensis* sp. nov. from the type locality (not preserved) (photo by K. Kunya).

**TABLE 2.** Comparison of Color and Pattern Features in Living Specimens within *Popeia* Subgenus (from David et al., 2009; Grismer et al., 2006; Vogel et al., 2004; and our observations on the new species)

Species	Vertebral spots (males)	Eye color		Postocular streak		Ventrolateral stripe		Tail
		in males	in females	in males	in females	in males	in females	
<i>T. (P.) barati</i>	Absent	Orange	Orange or yellow	Absent	Absent	Bicolor, wide	white	Rusty red, mottled, no clear border between green and rusty red
<i>T. (P.) buniana</i>	Absent	Copper and turquoise	Copper	Reddish-brown	Absent	Bicolor	white	Rusty red, mottled, no clear border between green and rusty red
<i>T. (P.) fucatus</i>	Present (rarely absent)	Yellowish-green, gold or copper	Yellowish-green, gold or copper	White or bicolor (sometimes absent)	Absent	Bicolor	white	Mostly rusty brown, mottled with brown, and white, or (W. Malaysia) laterally green, mottled with rusty brown, without sharp border
<i>T. (P.) nebularis</i>	Absent	Pale green	Pale green	Absent	Absent	White or blue	absent	Laterally green, rusty or dark brown above, with a sharp border between the two areas
<i>T. (P.) phuketensis</i>	Present	Copper	Copper	Bicolor, wide	Bicolor, narrow	Bicolor, red part wide	Bicolor, red part wide	Rusty red, mottled with white and green above with a sharp border between the rusty brown and green areas
<i>T. (P.) popeiorum</i>	Absent (rarely present)	Deep red	Deep red	Bicolor, wide	White, wide or absent	Bicolor, wide	white	Rusty red, mottled, no clear border between green and rusty red
<i>T. (P.) sabahi</i>	Absent (rarely present)	Deep red or orange	Deep red or orange	Absent	Absent	Bicolor	White or yellow	Rusty red, mottled, without sharp border between the green and rusty brown areas
<i>T. (P.) toba</i>	Absent	?*	?*	Absent	Absent	Thin, white	Faint or absent	Rusty red, mottled, without sharp border between the green and rusty brown areas

\* Color in life unknown.



**Fig. 8.** Biotope of *Trimeresurus (Popeia) phuketensis* sp. nov. on Phuket Island (photo by P. Samphanthamit).

*popeiorum* group: *Trimeresurus (Popeia) barati* Regenass and Kramer, 1981, *T. (P.) fucatus* Vogel, David and Pauwels, 2004, *T. (P.) nebularis* Vogel, David and Pauwels, 2004, *T. (P.) popeiorum* Smith, 1937, and *T. (P.) sabahi* Regenass and Kramer, 1981. We follow David et al. (2009) in regarding *Popeia* as a subgenus of *Trimeresurus* rather than a distinct genus. Two additional species were subsequently added to the *popeiorum* species group by their descriptors: *T. (P.) buniana* Grismer, Grismer and

McGuire, 2006, and *T. (P.) toba* David, Petri, Vogel and Doria, 2009. Seven *Trimeresurus (Popeia)* species are thus currently recognized, all well characterized and diagnosed in recent revisions or descriptions (Vogel et al., 2004; Grismer et al., 2006; David et al., 2009).

Comparison among patterns and main morphological characters of all *Popeia* species are provided in Tables 2 and 3, respectively. Its 21 MSR readily separate *T. (P.) phuketensis* sp. nov. from *T. (P.) barati*, which

**TABLE 3.** Comparison of Main Morphological Characters within *Popeia* Subgenus (from David et al., 2009, Grismer et al., 2006, Vogel et al., 2004, and our observations on the new species)

Species	TaL/TL		VEN		SC		MSR	CEP	SL
	males	females	males	females	males	females			
<i>T. (P.) barati</i>	0.19 – 0.23	0.16 – 0.18	142 – 153	146 – 158	62 – 73	55 – 59	17 – 19	9 – 13	9 – 11
<i>T. (P.) buniana</i>	0.22 – 0.23	0.22	170 – 174	170	76 – 78	61	19 – 21	11 – 14	9 – 10
<i>T. (P.) fucatus</i>	0.18 – 0.24	0.16 – 0.19	156 – 171	157 – 170	69 – 84	59 – 73	(19) 21	10 – 14	9 – 12
<i>T. (P.) nebularis</i>	0.19	0.17	149 – 153	147 – 153	61 – 65	50 – 60	(20) 21	9 (10)	9 – 11
<i>T. (P.) phuketensis</i>	0.19 – 0.23	0.17 – 0.18	166 – 172	163 – 172	76 – 79	63 – 65	21	9 – 12	10 – 12
<i>T. (P.) popeiorum</i>	0.18 – 0.21	0.15 – 0.17	151 – 166	154 – 168	59 – 75	56 – 64	(20) 21	10 – 14	9 – 11
<i>T. (P.) sabahi</i>	0.19 – 0.24	0.17 – 0.18	147 – 157	148 – 156	69 – 76	59 – 65	21	9 – 11	8 – 10
<i>T. (P.) toba</i>	0.22 – 0.23	0.15 – 0.16	153 – 155	153 – 156	73	57 – 64	21	10 – 12	9 – 10

shows only 17 or 19 MSR. Its high number of ventral scales (163 – 172) shows no overlap with ventral numbers in *T. (P.) barati*, *T. (P.) nebularis*, *T. (P.) sabahi*, and *T. (P.) toba* (see Table 3 and variation given in David et al., 2009, Grismer et al., 2006, Vogel et al., 2004), which show a maximal number of 158 [*T. (P.) barati*]. Its zigzag dorsal pattern in adults readily distinguishes it from adult *T. (P.) barati*, *T. (P.) nebularis*, *T. (P.) popeiorum*, *T. (P.) sabahi*, and *T. (P.) toba*. The presence of vertebral spots in males separates it from *T. (P.) barati*, *T. (P.) buniana*, *T. (P.) nebularis*, and *T. (P.) toba*. The presence in female *T. (P.) phuketensis* sp. nov. of a bicolor postorbital streak and of a bicolor ventrolateral stripe is unique among all *Popeia* species. Coloration in male *T. (P.) phuketensis* sp. nov. are most closely related to those of male *T. (P.) buniana* and *T. (P.) fucatus*. However, *T. (P.) buniana* males lack white vertebral spots, their postocular streak is unicolor and their eye is bicolor; male *T. (P.) fucatus* show a dorsal pattern that is less vivid and contrasted than that of *T. (P.) phuketensis* sp. nov. (see Table 2 and compare figures provided in the present work with Figs. 10 and 12 and color description in Vogel et al., 2004).

The postorbital streak and ventrolateral stripe patterns and their sexual dimorphism within each species are important diagnostic characters, extensively used in *Trimeresurus* systematics (David et al., 2001, 2002; Vogel et al., 2004). The state of these secondary sexual characters clearly separate *Trimeresurus (P.) phuketensis* from its congeners, as shown in Table 2.

Phuket Island benefited from dedicated snake diversity surveys during several years in the seventies (see a.o. Frith 1977, 1978), and was the object of several recent herpetological surveys (Leong et al., 2003; Das and Leong, 2004; Pauwels and Bauer, 2001). The following Viperidae were already recorded from the island: *Calloselasma rhodostoma* (Boie in Boie, 1827), *Trimeresurus (Cryptelytrops) purpureomaculatus* (Gray, 1832), *Tropidolaemus wagleri* Wagler, 1830 (Frith 1977; Frith and Frith 1975, personal observation), but so far no member of the subgenus *Popeia* had been found (Trutnau, 1986; Grossmann and Tillack, 2001a, 2001b; Nabhitabhata and Chan-ard, 2005; Nabhitabhata et al., “2000” 2004; Vogel et al., 2004).

The discovery of a new, colorful pitviper species in one of the few remaining forest patches of Phuket Island, one of the most visited touristical destinations of Thailand, is a clear indication that the herpetological inventory of Thailand is still very incomplete, even in some presumably best known environments. *Trimeresurus (Popeia) phuketensis* sp. nov. is the second reptile believed to be endemic to Phuket Island, along with the rock gecko *Cnemaspis phuketensis* Das and Leong, 2004

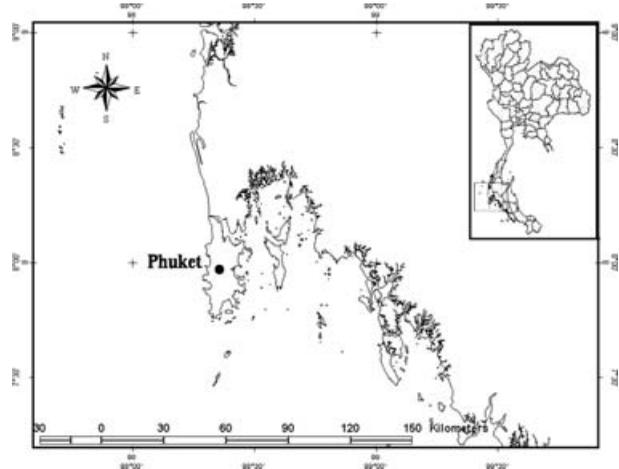


Fig. 9. Map of Thailand showing the type locality of *Trimeresurus (Popeia) phuketensis* sp. nov. (map by W. Sodob).

(Gekkonidae). It is the fifth insular species of the subgenus *Popeia*, which, including the presently described species, thus contains more than half (5 of 8) of insular species.

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