BIODIVERSITAS
Volume 19, Number 6, November 2018
Pages: 2111-2117

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d190617

Short Communication: *Cyrtodactylus elok* Dring, 1979 (Sauria, Gekkonidae): A first country record for Thailand

YODCHAIY CHUAYNKERN[1,♥], PECHRKAWIN NURNGSOMSRI[1,♥♥], CHANTIP CHUAYNKERN[1,♥♥♥], PRATEEP DUENGKAE[2,3,♥♥♥♥], SUNATE KARAPHAN[4,♥♥♥♥♥]

[1]Department of Biology, Faculty of Science, Khon Kaen University, Mueang Khon Kaen, Khon Kaen, 40002, Thailand
Tel.: +668-6005-2507, ♥email: yodchaiy@kku.ac.th; ♥♥email: Pechrkawin@nsm.or.th; ♥♥♥email: ichant@kku.ac.th
[2]Department of Forest Biology, Faculty of Forestry, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand. ♥♥♥♥email: prateep.du@ku.ac.th
[3]Center for Advanced Studies in Tropical Natural Resources, Kasetsart University. Chatuchak, Bangkok, 10900, Thailand.
[4]Pa Phru-Pa Bala Wildlife Research Station, Waeng, Narathiwat, 96160, Thailand. ♥♥♥♥♥email: karapann@gmail.com

Manuscript received: 17 August 2018. Revision accepted: 26 October 2018.

Abstract. *Chuaynkern Y, Nurngsomsri P, Chuaynkern C, Duengkae P, Karaphan S. 2018. Short Communication:* Cyrtodactylus elok *Dring, 1979 (Sauria, Gekkonidae): A first country record for Thailand. Biodiversitas 19: 2111-2117.* The present work reports a new country record for Thailand of the bent-toed gecko *Cyrtodactylus elok* Dring, 1979 based on a single specimen which was collected from Hala–Bala Wildlife Sanctuary, Narathiwat Province (southern Thailand). The Thai specimen shows morphological characters similar to *C. elok* as follows: 12-14 supralabials, 10-11 infralabials, seven tubercles across midbody, 49 ventral scales, enlarged femoral scales absent, tubercles on forelimbs absent, ventrolateral fold poorly defined, and large tubercles of dorsolateral caudal rows. The species was previously known from the discovery made in Malaysia. This addition brings the number of Thai prehensile-tailed species to three. Morphological and distributional maps are provided.

Keywords: *Cyrtodactylus brevipalmatus*, *Cyrtodactylus elok*, Narathiwat, new record, prehensile-tailed

INTRODUCTION

Presently, the bent-toed geckos genus *Cyrtodactylus* Gray, 1827 have paid attention to their diversity and approximately 260 species were recognized across Asia and western Pacific (Uetz et al. 2018). The prehensile-tailed *Cyrtodactylus* is a group of species with spiny, prehensile tails (Grismer et al. 2010), and presently comprise of nine nominal species: *C. interdigitalis* Ulber, 1993, *C. elok* Dring, 1979, *C. brevipalmatus* (Smith, 1923), *C. spinosus* Linkem, McGuire, Hayden, Setiadi, Bickford and Brown, 2008, *C. stresemanni* Rösler and Glaw, 2008, *C. nuaulu* Olivier, Edgar, Mumpuni, Iskandar and Lilley, 2009, *C. serratus* Kraus, 2007, *C. lateralis* (Werner, 1896), and *C. durio* Grismer, Anuar, Quah, Muin, Chan, Grismer and Ahmad, 2010. Among these members, two of them were known to occur in Thailand: *C. brevipalmatus*, and *C. interdigitalis*. The first species was described based on specimens collected from Khao Luang National Park, Nakhon Si Thammarat Province (Smith 1923). To date, *C. brevipalmatus* is currently endemic to Thailand (Grismer 2008; Harvey et al. 2016) and its distribution was reported in Tak, Nakhon Si Thammarat, Phetchaburi, Uthai Thani Provinces (Nabhitabhata et al. 2004; Nabhitabhata and Chan-ard 2005; Chuaynkern and Chuaynkern 2012).

The second species, *C. interdigitalis*, was described based on specimens collected from Nam Nao National Park, Phetchabun Province (Ulber 1993). Although several works (see e.g., Ulber 1993; Nabhitabhata et al. 2004; Nabhitabhata and Chan-ard 2005; Chan-ard and Makchai 2011; Chuaynkern and Chuaynkern 2012; Chan-ard et al. 2015) reported distribution of *C. interdigitalis* in many provincial areas (e.g., Tak, Bueng Kan, Phetchaburi, Phetchabun, Loei, Nong Khai, Uthai Thani Province), but recently Nurngsomsri et al. (2014) confirmed its distribution only in four provinces including Phetchabun (Nam Nao National Park), Uttaradit (Nam Paad Wildlife Sanctuary), Chaiyaphum (Phu Khiao Wildlife Sanctuary) and Loei (Phu Luang Wildlife Sanctuary).

The present work obtained a female specimen of the prehensile-tailed *Cyrtodactylus* collected from Hala–Bala Wildlife Sanctuary (Narathiwat Province). The specimen was investigated on its identity by comparing its morphological characteristics to relevant specimens and to morphological characteristics described in the taxonomic literature. As below, this specimen is identified as *C. elok* and we herein present the details of this investigation.

MATERIALS AND METHODS

A specimen (KKUC 01145, field number Y 0588) of the prehensile-tailed *Cyrtodactylus* was deposited in the Khon Kaen University Vertebrates Collection (KKUC, Khon Kaen University, Khon Kaen Province, northeastern Thailand). The specimen was identified by comparing their morphological characters with descriptions in relevant taxonomic works and comparative materials including two

specimens of *C. brevipalmatus* from the British Museum Natural History (BMNH, U.K.) and Zoologische Museum Berlin (ZMB, Germany), and three specimens of *C. elok* from Zoologische Museum Berlin (ZMB, Germany). Measurements were taken with a digital slide-caliper (to the nearest 0.1 mm). Measurement is presented in Table 1. Those of symmetrical characters are given in form of "left/right". Those of the subdigital lamellae formula of fingers and toes are given in form of "basal lamellae: 1: distal lamellae". The "1" indicates that the specimen has small scales interrupt between the basal and distal lamella. Some measurements are similar in definitions with those of previous publications (e.g., Bauer 2002, 2003): SVL, HL, HW, HH, SE, TYE, IN, EN, IUE, AG, LAL, and TAL. The present work conducted under the following animal ethic numbers: U1-04532-2559 (CC), U1-046369-2559 (YC), and U1-05804-2559 (PD).

RESULTS AND DISCUSSION

Cyrtodactylus elok Dring, 1979 (Figures 1-3).

Cyrtodactylus elok Dring, 1979: 223. Holotype: BMNH 1967.2783. Type locality: "base camp of the Gunung Benom expedition (215 m elevation)", Pahang, Peninsular Malaysia.

Material examined

Thailand: Narathiwat Province: Hala–Bala Wildlife Sanctuary [KKUC 01145, field number Y 0588]. Comparative materials were *C. brevipalmatus*: Thailand: Nakhon Si Thammarat Province: Khao Luang National Park [BMNH 1946.8.23.11, ZMB 50525], and *C. elok*: Malaysia [ZMB 64955, 70052-53].

Identification of the specimen

Identification of the specimen from Thailand was based on comparing with taxonomic works (Taylor 1963; Dring 1979; Grismer 2005, 2008; Grismer et al. 2010). The specimen was allocated to *C. elok* as it was mostly similar to those of publication as follows: tubercle across midbody five to 10, ventral scales 41-52, enlarged preanal scales six to nine, enlarged femoral scales absent, femoral pore absent, ventrolateral fold pale-edged, two level of ventrolateral

Table 1. Abbreviation and definition of measurements used in this study

Abb.	Characteristics	Definitions
SVL	Snout-vent length	Measured from tip of snout to vent
HL	Head length	Measured from tip of snout to back of mandible
HW	Head width	Measured at the widest position
HH	Head height	Measured at the highest position
RW	Rostral width	Measured the widest distance of rostral
RH	Rostral height	Measured the highest distance between lower and upper edges of rostral in vertical direction
ML	Mental length	Measured the longest distance of mental
MW	Mental width	Measured at the widest of mental
TYD	Ear-opening length	Measured distance between anterior and posterior through at horizontal position
SS	Snout to shoulder length	Measured from tip of snout to shoulder at anterior point of insertion of the arm
SE	Snout length	Measured from tip of snout to anterior edge of eye-ball
EL	Eye length	Measured distance between anterior and posterior edges of eye-ball at horizontal position
TYE	Tympanum to eye distance	Measured distance between posterior edge of eye-ball and anterior edge of ear opening
SN	Snout to nostril length	Measured from tip of snout to anterior nostril
IN	Internarial distance	Measured distance between nostrils
EN	Eye to nostril distance	Measured distance between nostril and anterior edge of eye-ball
IFE	Distance between anterior corners of eyes	Measured distance between anterior corners of eye-balls
IUE	Distance between upper eyelids	Measured distance between upper eyelids at narrowest position
IBE	Distance between posterior corners of eyes	Measured distance between posterior corners of eye-balls
SPL	Supranasal length	Measured from anterior to posterior edges at the longest position of supranasal
SPW	Supranasal width	Measured from the outer and inner edges at the widest position of supranasal
AG	Trunk length	Measured distance between axillary to groin
BH	Body height	Measured at midbody position
UAL	Upper arm length	Measured from anterior point insertion of the arm to elbow
LAL	Lower arm length	Measured from elbow to base of palmar
PAL	Palmar length	Measured from base of palmar to base of 3rd finger
FL	Femur length	Measured from center of cloacal to knee
TL	Tibia length	Measured from knee to base of plantar
PLL	Plantar length	Measured from base of plantar to base of 3rd toe
TAL	Tail length	Measured from center cloacal to tip of tail
F_5-F_5	Length of fingers	Measured from base of finger to tip of finger
T_1-T_5	Length of toes	Measured from base of toe to tip of toe

caudal fringe, tail square-shaped in cross-section, tip of tail rather white. However, the Thai specimen showed some morphological differences from the type specimens: supralabials 12-14 (eight to 11 in the holotype and paratype), infralabials 10/11 (nine to 10 in the holotype and paratype), 49 ventral scale rows at midbody (44 in the holotype), dorsal tubercle rounded weakly conical (dorsal tubercle rather rounded and flattened with a weak median keel holotype), nine enlarged preanal scales (eight to 10 in Grismer 2008).

The specimen from Thailand shows differentiation from *C. brevipalmatus* (see Tables 2, 3, and Figure 3) by a number of tubercle rows at midbody (six to 10 versus 12-18), in small femoral scale, in a number of subdigital lamellae on 4th toe (11-15 versus 16-19), and in tubercle of dorsolateral caudal row large.

Description of the Thai specimen

Size and general aspects. *Cyrtodactylus* of small size (SVL 54.8 mm), body slender. Tail complete (TAL 64.8 mm), tapering, 1.2 times longer than SVL, square in cross-section.

Head. Head triangular in dorsal view; moderately long (HL/SVL ratio 0.3), 1.3 times longer than wide (HL 15.6 mm, HW 11.6 mm); wide (HW/HL ratio 0.7); high (HH 8 mm, HH/HL ratio 0.5), 2 times shorter than head length. Snout triangular-shaped in dorsal view, acuminate-shaped in lateral view, 1.8 times longer (SE 7 mm) than eye (EL 3.8 mm). Canthus rostralis indistinct, rounded; loreal region weakly inflated. Interorbital space concave, narrower (IUE 2.4 mm) than internasal distance (IN 2.6 mm); distance between anterior corners of eye-balls (IFE 4 mm) 2 times in distance between posterior corners of eyes (IBE 7.8 mm). Nostrils rather rounded, 7 times closer to tip of snout (SN 1.1 mm) than to anterior edge of eye-ball (EN 7.6 mm). Eyes small (EL/HL ratio 0.2), 1.8 times shorter than distance between snout to anterior edge of eye-ball. Pupil crenate, vertical. Ear opening oval (TYD 0.5 mm), 7.6 times shorter than eye-ball diameter; distance between anterior edge of ear opening and posterior edge of eye-ball (TYE 4.6 mm) 9.2 times longer than ear opening diameter.

Table 2. Selected measurements (mm) and morphological characters of *Cyrtodactylus elok* from Thailand (KKUC 0145) and Malaysia (ZMB64955, 70052-53)

Characters	KKUC 01145 (Subadult)	ZMB 64955 Female	ZMB 70052 Female	ZMB 70053 Female
SVL	54.8	81	83	77.4
HL	15.6	21.6	23	21
HW	11.6	15.6	17	15
HH	8	9.5	10.6	8.9
RL	1	2.1	1.7	2
RW	1.6	2.7	4	4
SPL	0.5	0.5	0.7	0.5
SPW	1	1	1.4	1.2
ML	2	3	2.8	3
MW	1.6	2.6	2.6	2.4
SN	1.4	2	1.8	1.9
SE	7	8	9.8	8.2
SS	19.8	28.5	28	28.3
IN	2.6	2	3	14.7
EN	4.6	6	8	6.4
IFE	4	5.1	7.5	6.9
IBE	7.8	10.7	14.4	12.4
IUE	2.4	3.7	3	4.4
EL	3.8	6	6.5	6
TYE	4.9	6.7	8.4	6.7
TYD	0.5	1	0.6	1.4
AG	24	32	42	35.4
UAL	9	12.4	13.7	12
LAL	8	10.8	13	11
FL	13.9	17.4	18.7	16.3
TL	10.2	14.4	15.3	13.7
TAL	64.8	84	-	-
Relatively finger length	$F_4>F_3>F_5>F_2>F_1$	F_4, $F_3>F_2>F_5>F_1$	F_4, $F_3>F_2$, $F_5>F1$	F_4, $F_3>F_2>F_5>F_1$
Relatively toe length	$T_4>T_3>T_5>T_2>T_1$	$T_4>T_3>T_5$, $T_2>T_1$	$T_4>T_5>T_3>T_2>T_1$	$T_4>T_3>T_4>T_5>T_1$
Internasal	1	1	2	1
Tubercle row across middle body	7	7	10	6
Ventral scale rows	49	41	52	47
Preanal pores	-	-	7 minutes pit	-
Enlarged preanal scales	9	9	8	6
Subdigital lamellae under 4th toe	(9:1:6)	(9:1:4)	(11:1:3)	(10:1:4)

Figure 1. Dorsal and ventral views of *Cyrtodactylus elok* from Hala–Bala Wildlife Sanctuary in Narathiwat Province (KKUC 01145, SVL 54.8 mm)

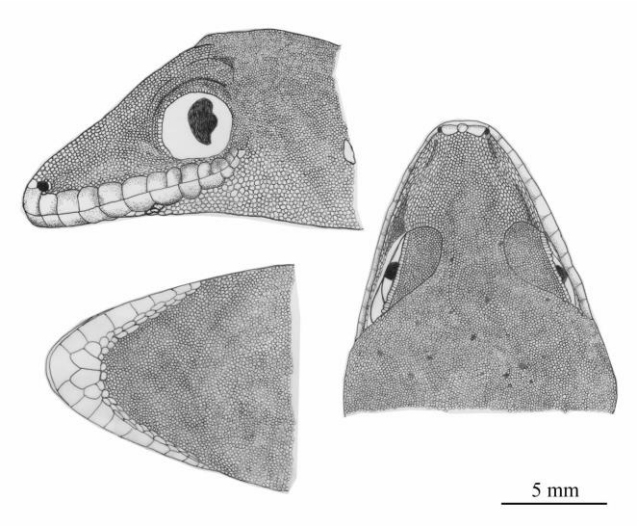

Figure 2. Head illustration of *Cyrtodactylus elok* (KKUC 01145); lateral (upper left), ventral (lower left) and dorsal (right) views

Body. Body slender, rather rectangular in cross-section; 1.2 times longer (AG 24 mm) than snout-shoulder length (SS 19.8 mm), 2.3 times shorter than snout-vent length.

Forelimbs. Arm moderately short and slim; upper arm 1.1 times longer (UAL 9 mm) than lower arm (LAL 8 mm); lower arm 2.7 times longer than hand (PAL 3 m). F_4 long (4.6 mm); F_3 (4 mm), F_2 (3.7 mm) and F_5 (3.4 mm) moderately long; F_1 (2.8 mm) short. Relative length of fingers: $F_4 > F_3 > F_2 > F_5 > F_1$. Webbing present.

Hind limbs. Leg moderately short; upper leg 1.4 times longer (FL 13.9 mm) than lower leg (TL 10.2 mm); lower leg 2.4 times longer than plantar (PLL 4.3 mm). T_4 long (6 mm); T_3 (5.2 mm), T_5 (5 mm) and T_2 (4.6 mm) moderately long; T_1 (2.7 mm) short. Relative length of toes: $T_4 > T_3 > T_5 > T_2 > T_1$. Webbing present.

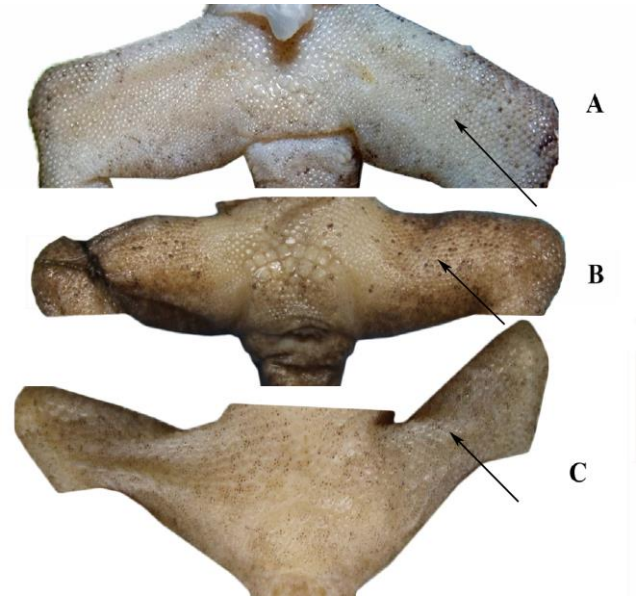

Figure 3. Cloacal and femoral regions comparison between *Cyrtodactylus elok* (A and B), and *C. brevipalmatus* (C). A (KKUC 01145, subadult female) and B (ZMB 70052, adult female) shows the absence of enlarged femoral scales. C (ZMB 50525, adult female) shows the presence of enlarged femoral scales. Photographs not scaled. Arrows indicate areas on non-enlarged and enlarged femoral scales

Scalation. Rostral rectangular, 1.6 times wider (RW 1.6 mm) than high (RH 1 mm), incomplete divided dorsally downward ca ½ of rostral height and terminated as Y-shaped; posterior bordered with two supranasals and internasal, lateral bordered with the 1st supralabial and nostril. Supranasal oval, 2 times wider (SPW 1 mm) than long (SPL 0.5 mm); anterior bordered with rostral, posterior bordered with granular scales on snout region, separated from each other by an internasal. Internasal single, small, anterior bordered with rostral, posterior bordered with granular scales on snout region, lateral bordered with supranasals. Supralabials 12/14, one to 10 equal size and then gradually reduced. Infralabials 10/11; 1st infralabial bordered with mental, 1st and 2nd chinshields, 2nd infralabial bordered with 2nd chinshield and subinfralabials, infralabials three to 11 bordered with subinfralabials. Snout region homogeneous granular scales. Upper eyelids granular scales with few dome weakly conical tubercles. Interorbital region homogeneous granular scales. Occipital region granular scales with few dome weakly conical tubercles. Temporal region granular scales with few dome weakly conical tubercles. Loreal region homogeneous granular scales. Mental triangular, 1.3 times wider (MW 2 mm) than long (ML 1.6 mm); lateral bordered with 1st infralabial; posterior bordered with 1st chinshield. 1st chinshield trapezoidal; anterior bordered with mental, and 1st infralabial; posterior bordered with small subinfralabials. 2nd chinshield rather rounded, smaller than 1st chinshield; anterior bordered with 1st chinshield, and first-two infralabials; posterior bordered with small subinfralabials. Subinfralabials oval, separated into two

rows; bordered with 2nd-6th infralabials and granular gular scales. Gular region homogeneous granular scales. Dorsal granular scales mixed with dome weakly conical tubercles. Dorsal tubercle rows across neck, midbody, and before vent: zero, seven, and three, respectively. Ventral scales rounded, overlapping; 49 ventral scale rows at midbody. Ventrolateral fold poorly defined. Preanal scales enlarged; femoral pores absent. Femoral scales not enlarged, equal size with scales on ventral part of thigh. Preanal pores absent. Dorsal part of upper arm homogeneous granular scales, ventral part rounded homogeneous scales. Dorsal part of lower arm homogeneous granular scales, ventral part rounded homogeneous scales. Palmar: dorsal part granular scales, ventral part rounded scales. Finger distal and basal subdigital lamellae separated by small scales. Finger subdigital lamellae formula: F_1 (7:1:3), F_2 (8:1:5), F_3 (9:1:5), F_4 (10:1:3), F_5 (8:1:5). Dorsal part of upper leg granular scales mixed with dome weakly conical tubercles, ventral part rounded homogeneous scales. Dorsal part of lower leg granular scales mixed with dome, weakly conical tubercles, ventral part rounded homogeneous scales. Plantar: dorsal part granular scales, ventral part rounded scales. Toe distal and basal subdigital lamellae separated by small scales. Toe subdigital lamellae formula: T_1 (7:1:5), T_2 (9:1:4), T_3 (10:1:6), T_4 (9:1:6), T_5 (6:1:4). Dorsal part of tail granular scales mixed with conical tubercles throughout the tail; ventral part round, small subcaudal scales, no enlarged subcaudal scales. Ventrolateral caudal spiny, alternation of a long spine and 2-3 short spines; prehensile-tailed present.

Coloration (in preservative). Dorsal part of head, body, forelimbs, hind limbs and tail grayish brown (tail tip white); pair of deltoid marking on nuchal, six pale dark brown narrows transverse bands on body; four dark brown caudal bands. Ventral part of head, body, forelimbs, hind limbs and tail grayish brown alternated with the dark brown ring of caudal bands.

Coloration (in life). not available.

Discussion

Description of a species of *C. elok* in the present work was based on a single subadult female, therefore secondary sex characteristics such as preanal and femoral pores were not available. However, the specimen is clearly belonging to *C. elok* by comparison with taxonomic works of other prehensile-tailed species. Since *C. elok* has been described as new to science in 1979 by J.C.M. Dring, the species was not recorded outside Malaysia, only new localities and specimens were added to the knowledge on *C. elok* (Grismer 2008; Hervey et al. 2016). The present work added one additional specimen to the species. In an aspect of the distribution of the species, we added Thailand as the second country of its distribution range (Figure 4).

Although the addition of the present work brings the number of Thai prehensile-tailed *Cyrtodactylus* to three species (i.e., *C. brevipalmatus*, *C. elok*, and *C. interdigitalis*), intensive investigation in terms of taxonomy and distribution of this group is still required. Before 1993, only one species of the prehensile-tailed *Cyrtodactylus* was known to be found in Thailand: *C. brevipalmatus*. Smith (1923) described this species based on two specimens from "Khao Luang, Nakhon Si Thammarat Mountains". Subsequent work by Taylor (1963) included *C. brevipalmatus* in the lizard fauna of Thailand but no addition specimens were included in this work. Later, Ulber (1993) described another new species of the prehensile-tailed *Cyrtodactylus* named *C. interdigitalis* on the basis of five new specimens collected from Phetchabun Province (Nam Nao National Park) by the late Jarujin Nabhitabhata in 1991. This discovery brought the number of this group to two species. Subsequent works such as books and checklists included these two species in the fauna of the country (Nabhitabhata et al. 2004; Nabhitabhata and Chan-ard 2005; Das 2010; Chuaynkern and Chuaynkern 2012; Chan-ard et al. 2015).

Table 3. Comparison of *Cyrtodactylus elok* and other prehensile-tailed species from Thailand

Characters/species	*C. elok* Thailand	*C. elok* Malaysia	*C. elok* Lit.	*C. brevipalmatus* BMNH 1946.8.23.11	*C. brevipalmatus* Lit.	*C. interdigitalis* Lit.
SVL maximum	54.8	83	67.5	63	71	80
Infralabials	10-11	10-12	9	10-9	10-10	10-12
Tubercles across midbody	7	6-10	5-10	16	18	18-22
Ventral scales	49	41-52	44	40	37	37-42
Number of enlarged preanal scales	9	6-9	8	9	7-10	14
Number of preanal pores	0	0, 7 pit	0 (♂8)	♂9	0 (♂9-10)	0 (♂14)
Enlarged femoral scales	No	No	No	Yes	Yes	yes
Number of femoral pores	0	0	0	6-7	0 (♂6-7)	0 (♂8-9)
Tubercles on forelimbs	No	No	Yes	Yes	Yes	Yes
Ventrolateral fold	Poor	Poor	Poor	Distinct	Distinct	Distinct
Tubercle of dorsolateral caudal rows	Large	large	Large	Small	Small	Small
Number of subdigital lamellae on 4th toe	15	11-14	18-19	13	18-20	18-20
Two level of ventrolateral caudal fringe	Yes	Yes	Yes	No	-	No
Contact of posterior thigh scales abrupt	No	No	No	Yes	Yes	Yes
Tail in cross-section	Square	Square	Square	Slightly circular	Slightly circular	Slightly circular
1/3 tip of tail rather white color	Yes	Yes	Yes	No	-	No
Caudal segment	Wide	wide	Wide	Narrow	Narrow	Narrow

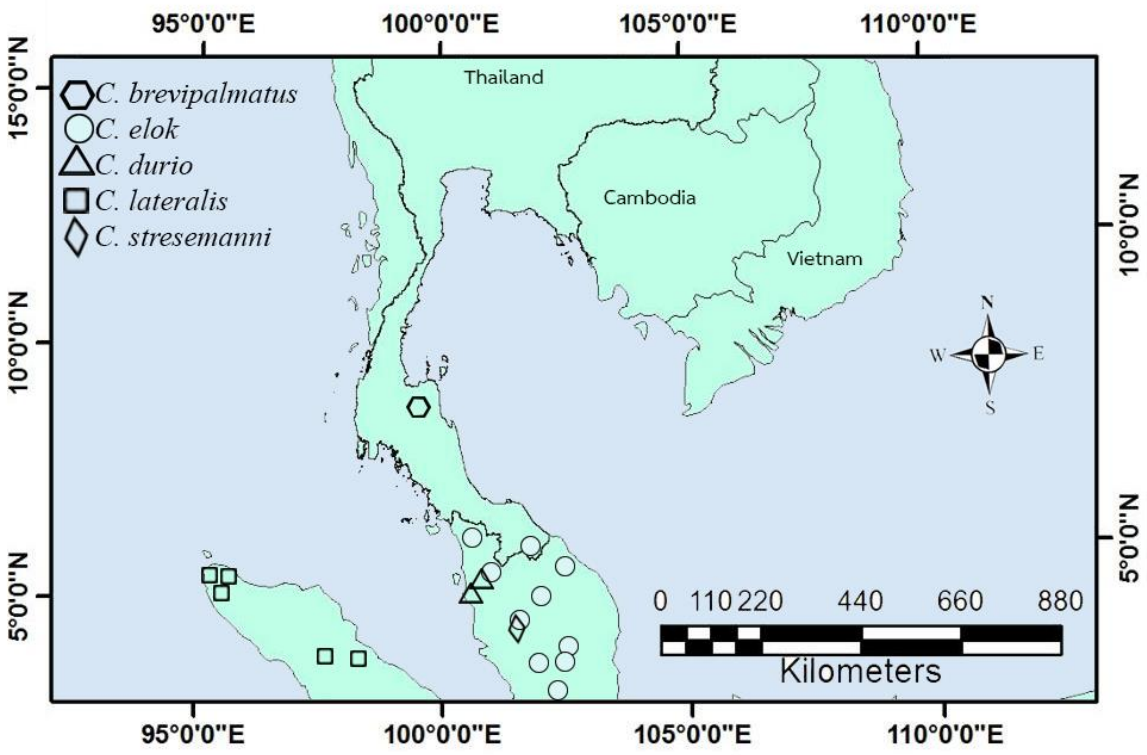

Figure 4. Known distribution of *Cyrtodactylus elok* (localities of *C. brevipalmatus*, *C. elok* [for outside Thailand], *C. durio*, *C. lateralis*, and *C. stresemanni* obtained from Harvey et al. 2016)

The prehensile-tailed *Cyrtodactylus* comprises of two clades (Harvey et al. 2016), the mainland SE Asian clade (including *C. elok*, *C. interdigitalis*, and *C. brevipalmatus*) and the insular clade (including *C. durio*, *C. lateralis*, *C. nuaulu*, *C. serratus*, *C. spinosus*, and *C. stresemanni*). Within the mainland SE Asian clade, DNA sequence data based on the NADH Dehydrogenase two-gene (ND2) supports a close relationship between *C. elok* (from Malaysia), and *C. interdigitalis* (from Lao PDR). Unfortunately, DNA sequence data of *C. brevipalmatus* was not available for this analysis. In Harvey et al. (2016), phylogeny based on morphology with three species added to original hypothesis of Grismer et al. (2010) supports a close relationship between *C. elok* and *C. brevipalmatus* with *C. interdigitalis* as a sister species to this clade. Therefore, adding of DNA sequence of *C. brevipalmatus* in further phylogenetic analysis is still required for discovering the phylogenetic position of *C. brevipalmatus*.

Particular the prehensile-tailed *Cyrtodactylus* recorded from Thailand, the intensive study of taxonomy is still a revision. Since the first species of this group (*C. brevipalmatus*) has been discovered in 1923 (Smith 1923), their extended distribution was added in several works (Cox et al. 1998; Nabhitabhata et al. 2004; Nabhitabhata and Chan-ard 2005; Grismer 2008; Das 2010; Chuaynkern and Chuaynkern 2012; Chan-ard et al. 2015) but such works did not provide information on voucher specimens. Furthermore, the second species (*C. interdigitalis*) was recorded wider distribution than previously known (Nurngsomsri et al. 2014). Therefore, additional specimens of this group from overlapping areas (southern part upward through the western to northern Thailand) between *C. brevipalmatus* and *C. elok*, and as well as in the area connected of northern and northeastern Thailand are important for the intensive study in the future.

ACKNOWLEDGEMENTS

The authors are grateful to following institutes for facilitating this study: Khon Kaen University (Khon Kaen Province, Thailand), Kasetsart University (Bangkok, Thailand), and Department of National Park, Wildlife and Plant Conservation. For loaning and facilitated examining specimens, we also grateful to following institutes and persons: British Museum Natural History (Patrick Campbell), Field Museum of Natural History (Alan Resetar), Khon Kaen University Vertebrates Collection (Dr. Yodchaiy Chuaynkern), Muséum national d'Histoire Naturelle (Prof. Annemarie Ohler), Museum d'Histoire Naturelle, Route de Malagnou (Dr. Andréas Schmitz and Mr Alain Merguin), Museo Civico di Storia Naturale di Genova (Dr. Raffael Ernst), Princess Maha Chakri Sirindhorn Natural History Museum (Dr. Pipat Soisook and Ms Wanitchaya Tirakunpisut), Thailand Natural History Museum (Dr. Somchai Bussarawit, Tanya Chan-ard, and Sunchai Makchai), Zoologisches Forschungsmuseum Alexander Koenig and Museum für Tierkunde (Dr.

Wolfgang Böhme and Mr Morris Flecks), Zoologische Staatssammlung München (Dr. Frank Glaw), Collectiebeheerder Reptielen en Amfibieën (Dr. Esther Dondorp), Zoologische Museum Berlin (Dr. Frank Tillack and Dr. Mark-Oliver Rödel). For grants, this work was partially supported by the following: (i) the Research Support Scholarship (Ms. Pechrkawin Nurngsomsri), (ii) Funding for graduate students to study abroad (Ms Pechrkawin Nurngsomsri), (iii) Funding for strengthening the research of professors by supporting graduate students (Dr. Yodchaiy Chuaynkern and Ms. Pechrkawin Nurngsomsri). Dr. Prateep Duengkae is the recipient of Research Chair Grant, the National Science and Technology Development Agency (NSTDA), Thailand. Our special thank goes to Dr. Robert H. Orr for assistance with the English-language manuscript.

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