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Article



Cyrtodactylus dumnuii (Squamata: Gekkonidae), a new cave-dwelling gecko from Chiang Mai Province, Thailand

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Abstract

A new cave-dwelling species of *Cyrtodactylus* is described from Chiang Mai Province in northern Thailand. *Cyrtodactylus dumnuii* **sp. nov.** may be distinguished from all other congeners by the possession of a series of enlarged femoral scales, disjunct precloacal and femoral pores in males (minute precloacal pores variably present in females), a relatively high number (18–22) of closely spaced, regularly arranged dorsal tubercle rows, well-defined non-denticulate ventrolateral folds, transversely enlarged subcaudal plates, and a color pattern of approximately six pairs of alternating light and dark transverse bands on the trunk. It is the nineteenth member of the genus recorded from Thailand and the eighth Thai *Cyrtodactylus* known to be a facultative troglophile.

Key words: Thailand, Chiang Mai, Reptilia, Gekkonidae, Cyrtodactylus dumnuii, new species, taxonomy, cave-dwelling

Introduction

Bent-toed geckos of the genus *Cyrtodactylus* Gray are the most species-rich of all gekkotan genera, with approximately 120 species. Roughly half of these have been described in the last decade (Uetz 2010). The greatest rate of new discovery in the group has been in Southeast Asia. For example, extensive recent work in Vietnam has revealed nineteen, mostly endemic species, many associated with karst substrates or limestone caves (e.g., Nazarov *et al.* 2008; Ngo 2008; Ngo & Bauer 2008; Ngo *et al.* 2008; Ziegler *et al.* 2010 and references therein). In Thailand Bauer *et al.* (2002) recognized 13 species of *Cyrtodactylus*. Another five species have subsequently been described from diverse localities around the country (Bauer *et al.* 2003; Pauwels *et al.* 2004; Bauer *et al.* 2009; Sumontha *et al.* 2010), including several from limestone caves (see Sumontha *et al.* 2010). We here describe another new Thai gecko from an area of limestone caves in the northwestern province of Chiang Mai.

Material and methods

The following measurements were taken with digital calipers to the nearest 0.1 mm following the methods of Bauer (2002, 2003): CrusL: crus length; EarL: ear length; EyeEar: eye to ear distance; ForeaL: forearm length; HeadH: head height; HeadL: head length; HeadW: head width; Internar: internarial distance; Interorb: interorbital distance; NarEye: nares to eye distance; OrbD: orbital diameter; SnEye: snout to eye distance; SVL: snout-vent length; TailL: tail length; TailW: tail width; TrunkL: trunk length. Basal subdigital lamellae

were counted from the most proximal lamella at least twice as large as adjacent palmar scales. Measurements and scale counts based on right side of animals unless otherwise noted. Scale counts and external observations of morphology were made using a Nikon SMZ1000 stereo dissecting microscope.

Comparisons were made with museum material in the collections of the California Academy of Sciences, San Francisco (CAS), Chulalongkorn University Museum of Zoology, Herpetological Section, Bangkok (CUMZ R), Institut Royal des Sciences Naturelles de Belgique, Brussels (IRSNB), Khorat Zoo Museum, Nakhonratchasima (KZM), Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ), Thailand Natural History Museum, National Science Museum, Technopolis (THNHM), and United States National Museum, Washington, D.C. (USNM). See Bauer *et al.* (2002, 2003, 2009), Pauwels *et al.* (2004), and Sumontha *et al.* (2010) for lists of comparative specimens examined. Original published descriptions and descriptions provided in broader faunal and taxonomic treatments (e.g., Smith 1935; Taylor 1963; Youmans & Grismer 2006; Rösler & Glaw 2008) were also consulted.

Cyrtodactylus dumnuii sp. nov.

Figures 1-4.

Holotype. THNHM 15904 [formerly Montri Sumontha field series (MS) 302], adult male (Figure 1); Thailand, Chiang Mai Province, Chiang Dao District, Mae-Na Subdistrict, Ban Thakilek, Tham (Cave) Phabartmaejon, 19°20'34" N, 99°01'37"E, 486 m a.s.l., collected by Kirati Kunya, 26 December 2005.

Paratypes. THNHM 15905 [MS 201], adult female, CUMZ R 2009-6-24-5 [MS 202], adult male; same data as holotype. KZM 002 [MS 181], adult female, CUMZ R 2009-6-24-6 [MS 182], adult female (Figure 2); same locality as holotype, collected by Kirati Kunya, 30 March 2005.

Etymology. We are pleased to name this new species in honor of Mr. Sophon Dumnui, Director of the Zoological Park Organization under the Royal Patronage of His Majesty The King of Thailand. We suggest the following common names: Tuk kai Dumnui (Thai), Dumnui's bent toed gecko (English), Cyrtodactyle de Dumnui (French), Dumnuis Bogenfingergecko (German), Kromvingergekko van Dumnui (Dutch).

Diagnosis. A moderately sized *Cyrtodactylus*, snout-vent length to at least 84 mm; body slender, limbs and digits long, slender, tail much longer than SVL; one pair of greatly enlarged postmental scales in broad contact with one another; no internasal scales; dorsal scalation with 18–22 regularly arranged rows of keeled tubercles; approximately 40 ventral scales across belly between well-developed, non-denticulate ventrolateral folds; no precloacal groove, 5–6 precloacal pores separated by a diastema of 10–11 poreless scales from a series of 6 small femoral pores borne on a row of enlarged femoral scales in males, femoral pores absent and tiny precloacal pores variably present in females; nine broad basal lamellae and ten narrow distal lamellae beneath 4th toe of pes; median subcaudal scales enlarged to form broad transverse plates; dorsal pattern of alternating light and dark transverse bands on occiput, nape, and body, 6–7 such dark bands between shoulder and sacrum, dark band on occiput usually broken medially.

Description of holotype. Adult male. SVL 81.2 mm; TailL 100.2 mm (91.4 mm regenerated). Head relatively long (HeadL/SVL ratio 0.29), wide (HeadW/HeadL ratio 0.69), not markedly depressed (HeadH/ HeadL ratio 0.44), distinct from slender neck. Loreal region weakly inflated, canthus rostralis not prominent. Snout elongate (SnEye/HeadL ratio 0.41), rounded; longer than eye diameter (OrbD/SnEye ratio 0.63); scales on snout small, rounded to oval, granular to weakly conical, mostly homogeneous, larger than those on crown, interorbital and occipital regions. Eye large (OrbD/HeadL ratio 0.26); pupil vertical with crenelated margins; supraciliaries short, those at posterior of orbit bearing small conical spines. Ear opening vertically elliptical, large (EarL/HeadL ratio 0.09); eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.10). Rostral much wider (3.46 mm) than deep (2.16 mm), rostral crease very short (< ¹/₄ height of rostral). Two enlarged supranasals in broad contact with one another, no internasals. Rostral in contact with first supralabials, nostrils, and supranasals. Nostrils oval, more-or-less laterally directed, each surrounded by supranasal, rostral, first supralabial and two enlarged postnasals. Two to three rows of small scales separate orbit from supralabials. Mental triangular, wider (3.33 mm) than deep (2.82 mm). A single pair of greatly enlarged postmentals in broad contact behind mental, each postmental bordered anteromedially by mental,

anterolaterally by first infralabial and anterior portion of second infralabial, posterolaterally by an enlarged lateral chinshield (or second postmental), and posteriorly by three granules, the medialmost of which also contacts the other postmental. Supralabials to midorbital position 9/9; enlarged supralabials to angle of jaws 13/12. Infralabials 10/11. Interorbital scale rows across narrowest point of frontal bone 15.



FIGURE 1. Adult male holotype of *Cyrtodactylus dumnuii* **sp. nov.** (THNHM 15904) from Tham (Cave) Phabartmaejon, Ban Thakilek, Mae-Na Subdistrict, Chiang Dao District, Chiang Mai Province, Thailand. Scale bar equals 20 mm.

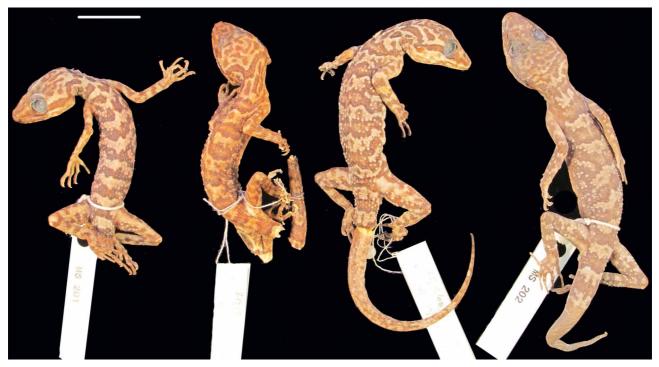


FIGURE 2. Paratype series of *Cyrtodactylus dumnuii* **sp. nov.** From left to right: MS THNHM 15905 (female), CUMZ R 2009-6-24-6 (female), KZM 002 (female), CUMZ R 2009-6-24-5 (male). Note the variation in the dorsal color pattern and the occipital band. Scale bar equals 20 mm.

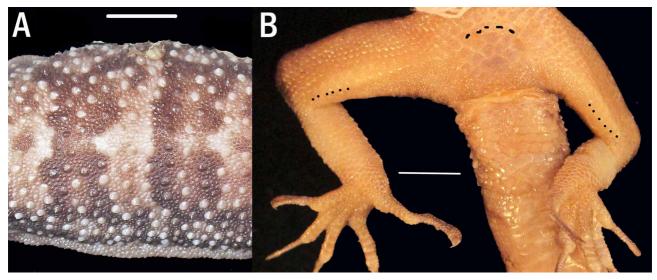


FIGURE 3. (A) Trunk scalation of the holotype of *Cyrtodactylus dumnuii* **sp. nov.** at midbody. Note the well-developed ventrolateral fold and the relatively dense packing of the keeled dorsal tubercles. (B) Ventral view of cloacal region illustrating the enlarged femoral scale row. The position and approximate size of precloacal and femoral scales are indicated by the black markings. Scale bar in both panels equals 5 mm.



FIGURE 4. Life photos of *Cyrtodactylus dumnuii* **sp. nov.** (A) Uncollected adult specimen from type locality. (B) Captive specimen. Note the slender tail and green iris.

Body slender, elongate (TrunkL/SVL ratio 0.44) with well defined, non-denticulate ventrolateral folds. Dorsal scales weakly heterogeneous, domed to conical; regularly distributed tubercles (4-5 times size of adjacent scales) extending from shoulder region on to tail base, smaller tubercles on postocular region, crown, occiput, and nape; most tubercles bearing a keel, those on flanks conical, often lacking a distinct keel, those on posterior trunk and sacral region most prominent; tubercles in 22 regular rows at midbody, typically separated from one another by 1–2 dorsal granules, three or more mid-dorsally (Figure 3A). Ventral scales larger than dorsals, smooth, oval and subimbricate, largest on posterior abdomen and in precloacal region. Midbody scale rows across belly to lowest rows of tubercles 40. Gular region with homogeneous, smooth, juxtaposed granular scales.

Five precloacal pores in continuous series. No precloacal groove. A continuous row of enlarged femoral scales, each about twice the size of adjacent anterior femoral scales, extending along length of femur and

continuous with the precloacal pore-bearing scales. Six (left) to seven (right) tiny femoral pores in distal scales of enlarged femoral scales, separated by 10 (right) to 11 (left) poreless scales from precloacal series (Figure 3B). Postcloacal spurs each bearing three enlarged, smooth scales.

Scales on palm and sole smooth, rounded to oval or hexagonal, slightly domed. Scalation on dorsal surfaces of limbs similar to body dorsum with enlarged, conical tubercles interspersed among smaller scales; tubercles separated from one another by 1–2 small scales, or in direct contact with one another. Fore and hindlimbs moderately long, slender (ForeaL/SVL ratio 0.16; CrusL/SVL ratio 0.20). Digits long, slender, inflected at interphalangeal joints, all bearing robust, slightly recurved claws. Basal subdigital lamellae broad, ovoid to rectangular, without scansorial surfaces (5-7-7-6-8 right manus; 6-7-7-9-8 right pes); narrow lamellae distal to digital inflection and not including ventral claw sheath: 9-9-11-10-8 (right manus), 10-9-11-10-9 (right pes); very weakly developed interdigital webbing between digits (except IV and V). Relative length of digits: IV>III>II>V>I (manus); V>IV~III>II>I (pes). Mostly regenerated tail, long, slightly depressed, gently tapering to pointed tip; longer than SVL (TailL/SVL ratio 1.23). Tail with enlarged median subcaudal plates.

Coloration in ethanol. Dorsum of alternating whitish to grayish-brown and chocolate brown transverse bands; chocolate bands with paler centers, grayish-brown bands often with darker centers. Six dark bands from shoulder to sacrum, another on tail base. Additional incomplete dark bands on nape and occiput. Dark bands fusing near ventrolateral margin of trunk. Most dorsal tubercles, except those on darkest brown areas, whitish. Dorsum of head medium brown with irregular cream to grayish markings between occipital band and posterior margin of orbit. A chocolate brown stripe extends from lower posterior corner of orbit, forms a right angle above the tympanum, and passes medially to form the broken occipital band. A vague pale canthal stripe is present. Supra- and infralabials mottled brown and gray, darkest anteriorly. Dorsal surfaces of limbs with alternating chocolate and gray-brown markings, palms grayish. Dorsum of regenerated tail light brown with irregular beige to cream markings. Dorsal trunk coloration ends abruptly at ventrolateral folds. Venter beige with brown speckling, densest under chin, on lower abdomen and precloacal region, under thighs, and at lateral margins. Tail venter mottled gray-brown.

Color in life (based on photographs of uncatalogued specimens, Figure 4) similar to that in preservative. Iris green, rims of orbits and posterior supralabials pale yellowish to white.

Variation. Comparative mensural data for the holotype and paratypes are given in Table 1. Meristic characters of the paratypes mostly correspond to those of the holotype except as noted. Rows of tubercles 18–20 in paratypes (Tabler 1). Male paratype with six precloacal pores separated by 11 poreless scales from a series of six femoral pores on each thigh. Female paratypes with no femoral pores and 0–7 precloacal pores (Table 1); if present, precloacal pores minute. Original portion of tail of CUMZ R 2009-6-24-6 weakly differentiated into annuli, with two subcaudal plates corresponding to eight rows of small, rectangular, subimbricate dorsal scales, decreasing to seven, then six such rows posteriorly. Dorsally original tail with cream blotches separated by more extensive brown markings. THNHM 15905 with seven dark transverse bands between shoulders and sacrum. CUMZ R 2009-6-24-6 with occipital band complete, partly complete in CUMZ R 2009-6-24-5. In living non-type specimens (Figure 4) the slender original tail exhibits 13–14 ashy blotches or rings on a chocolate to purplish-brown background. Caudal tubercles are limited to the pygal portion of the tail only.

Comparisons with other species. As discussed by Bauer *et al.* (2009), a number of geographically coherent and/or phenotypically similar clusters of species of *Cyrtodactylus* have recently been recognized in the literature. However, a comprehensive phylogenetic frame work for the group is still pending. We therefore provide comparisons of *C. dumnuii* **sp. nov.** to all of the *Cyrtodactylus* species described as of 1 April 2010 (exclusive of the distinctive South Asian *Geckoella*, sometimes considered as a subgenus of *Cyrtodactylus*, and a number of bent-toed geckos of questionable generic allocation occurring in Nepal, northern India, and Tibet [Xizang Autonomous Region]).

Rösler and Glaw (2008) provided an extensive table summarizing a diversity of features across nearly 100 species of *Cyrtodactylus* sensu lato. Because of the incredible rate at which new *Cyrtodactylus* have been described from southeast Asia, this set of comparisons is already somewhat outdated. Data from additional taxa and corrections to Rösler and Glaw's (2008) data were derived from Oliver *et al.* (2008), Grismer &

Norhayati (2008), Grismer *et al.* (2008), Linkem *et al.* (2008), Nazarov *et al.* (2008), Ngo (2008), Ngo & Bauer (2008), Ngo *et al.* (2008), Rösler *et al.* (2008), Bauer *et al.* (2009), Geissler *et al.* (2009), Welton *et al.* (2009, 2010), Chan & Norhayati (2010), Sumontha *et al.* (2010), and Ziegler *et al.* (2010).

TABLE 1. Mensural and selected meristic data for the type series of <i>Cyrtodactylus dumnuii</i> sp. nov . DorTub =
Longitudinal Rows of Dorsal Tubercles, PreclP = Precloacal Pores, FemP = Femoral Pores (Left-Right), other
abbreviations as in Materials and methods. All measurements in mm. * = head damaged, reliable measurements not
possible.

	THNHM 15904 Holotype	CUMZ R 2009-6-24-5 Paratype	KZM 002 Paratype	CUMZ R 2009-6-24-6 Paratype	THNHM 15905 Paratype
Sex	male	male	female	female	female
SVL	81.2	84.2	83.6	76.2	76.5
ForeaL	12.8	14.5	13.8	13.6	12.9
CrusL	15.9	17.2	16.3	15.3	15.4
TailL	100.2 (8.8 original)	54.0 (17.4 original)	95.1 (9.1 original)	33.6 (broken)	7.1
TailW	7.8	7.5	6.7	4.4	_
TrunkL	35.6	36.1	35.4	34.7	33.3
HeadL	23.4	23.4	23.1	22.8	23.3
HeadW	16.1	16.4	16.0	14.8	14.6
HeadH	10.4	*	10.0	10.2	8.5
OrbD	6.0	5.2	5.7	6.1	6.0
EyeEar	6.6	6.9	6.6	6.2	5.7
SnEye	9.7	10.2	9.7	9.4	9.1
NarEye	7.0	7.2	6.8	7.0	6.5
Interorb	3.6/7.5	*	3.7/7.7	3.3/7.6	3.4/7.2
EarL	2.1	2.2	2.7	2.4	2.7
Internar	2.6	2.7	2.7	2.5	2.6
DorTub	22	20	18	18	20
PreclP	5	6	5	0	7
FemP	6–7	6–6	0	0	0

The presence in males of separate series of femoral pores (versus no femoral pores or continuous precloacal-femoral pores) in *C. dumnuii* distinguishes it from *C. angularis* (Smith), *C. chanhomeae* Bauer *et al., C. intermedius* (Smith), *C. jarujini* Ulber, *C. oldhami* (Theobald), *C. papilionoides* Ulber & Grossmann, *C. peguensis* (Boulenger), *C. quadrivirgatus* Taylor, *C. sumonthai* Bauer *et al., C. thirakhupti* Pauwels *et al.,* and *C. variegatus* (Blyth), among Thai congeners and from the following extralimital species: *C. adleri* Das, *C. annulatus* (Taylor), *C. aurensis* Grismer, *C. ayeyarwadyensis* Bauer; *C. badenensis* Nguyen *et al., C. batucolus* Grismer *et al., C. brevidactylus* Bauer, *C. cattienensis* Geissler *et al., C. cavernicolus* Inger & King, *C. chauquangensis* Hoang *et al., C. condorensis* (Smith), *C. consobrinoides* (Annandale), *C. cracens* Batuwita & Bahir; *C. cryptus* Heidrich *et al., C. deveti* (Brongersma), *C. edwardtaylori* Batuwita & Bahir; *C. gansi* Bauer, *C. halmahericus* (Mertens), *C. hontreensis* Ngo *et al., C. ingeri* Hikida, *C. irianjayaensis* Rösler, *C. irregularis* (Smith), *C. khasiensis* (Jerdon), *C. klugei* Kraus, *C. lateralis* (Werner), *C. malayanus* (de Rooij), *C. malcolmsmithi* (Constable), *C. matsuii* Hikida, *C. nigriocularis* Nguyen *et al., C. pantiensis* Grismer *et al., C. papuensis* (Brongersma), *C. paradoxus* (Darevsky & Szczerbak), *C. phongnhakebangensis* Ziegler *et al., C. pseudoquadrivirgatus* Rösler *et al., C. pubisulcus* Inger, *C. ramboda*

Batuwita & Bahir, C. robustus Kraus, C. roesleri Ziegler et al., C. rubidus (Blyth), C. seribuatensis Youmans & Grismer; C. sermowaiensis (de Rooij), C. serratus Kraus, C. soba Batuwita & Bahir; C. stresemanni Rösler & Glaw, C. subsolanus Batuwita & Bahir; C. sworderi (Smith), C. tautbatorum Welton et al., C. tiomanensis Das & Lim, C. tuberculatus (Lucas & Frost), and C. yoshii Hikida.

The presence of precloacal pores in males distinguishes *C. dumnuii* from *C. eisenmanae* Ngo; *C. gordongekkoi* (Das), *C. jellesmae* (Boulenger), *C. laevigatus* Darevsky, *C. semenanjungensis* Grismer & Leong, and *C. wallacei* Hayden *et al.* It differs from its Thai congeners *C. consobrinus* (Peters), *C. interdigitalis* Ulber and *C. tigroides* Bauer *et al.*, as well as *C. aaroni* Günther & Rösler, *C. aequalis* Bauer, *C. baluensis* (Mocquard), *C. caovansungi* Orlov *et al.*, *C. louisiadensis* (de Vis), *C. mimikanus* (Boulenger), *C. russelli* Bauer, *C. salomonensis* Rösler *et al.*, *C. slowinskii* Bauer, and *C. tripartitus* Kraus in a lower number of precloacal pores (5–6 versus 7 or more [usually 9 or more]).

Cyrtodactylus dumnuii may be distinguished from *C. macrotuberculatus* Grismer & Norhayati, *C. philippinicus* (Steindachner), *C. spinosus* Linkem *et al.*, and the Thai species *C. pulchellus* Gray, by the absence of a longitudinal or steeply angled precloacal sulcus or groove, from *C. marmoratus* (Kuhl) and *C. sadleiri* Wells & Wellington by the absence of a recessed transverse precloacal groove, from *C. biordinis* Brown & McCoy by the presence of a single, *versus* double row of femoral pores, and from *C. chrysopylos* Bauer by the absence of an enlarged pore-bearing scale posterior to the precloacal pore row. An enlarged series of femoral scales separates the new species from *C. annandalei* Bauer, *C. buchardi* David *et al.*, *C. grismeri* Ngo, *C. murua* Kraus & Allison, and *C. wakeorum* Bauer.



FIGURE 5. Map of Thailand showing the type locality of *Cyrtodactylus dumnuii* **sp. nov.** Tham Phabartmaejon (white dot), in Chiang Mai Province (shaded black).



FIGURE 6. Tham Phabartmaejon, type locality of *Cyrtodactylus dumnuii* **sp. nov.** (A) View of Phabartmaejon Hill showing its isolation and relatively small size. (B) Phabartmaejon Cave entrance.

The new species may be distinguished from the Thai species *C. brevipalmatus* (Smith) and the extralimital congeners *C. agamensis* (Bleeker), *C. agusanensis* (Taylor), *C. capreoloides* Rösler *et al.*, *C. darmandvillei* (Weber), *C. derongo* Brown & Parker, *C. gubernatoris* (Annandale), *C. huynhi* Ngo & Bauer, *C. jarakensis* Grismer *et al.*, *C. loriae* (Boulenger), *C. novaeguineae* (Schlegel), *C. papilionoides* Ulber & Grossmann, *C. wetariensis* (Dunn), *C. ziegleri* Nazarov *et al.*, and *C. zugi* Oliver *et al.* by the presence of enlarged subcaudal plates in the original tail and from *C. redimiculus* King and *C. takouensis* Ngo & Bauer by its greater number of rows of dorsal tubercles (18–22 *versus* 14–16 and 10, respectively). Finally, *C. dumnuii* also differs from its most recently described Thai congeners; from *C. erythrops* Bauer *et al.* it is distinguished by its greater number of scales across the venter at midbody (40 *versus* 28), and from *C. auribalteatus* Sumontha *et al.* it differs in having 6–7 (versus 4) dark bands from the shoulders to the sacrum.

Distribution and natural history. *Cyrtodactylus dumnuii* has been collected only from a single locality near the Myanmar border in Chiang Mai Province in the northwest of Thailand (Figure 5). Specimens were collected inside the entrance and up to 30 m within Tham (Cave) Phabartmaejon (Figure 6), during daylight hours.

Discussion

Cyrtodactylus dumnuii is the nineteenth species of bent-toed gecko to be recorded from Thailand and like many of its recently described congeners, both in Thailand and elsewhere in southeast Asia (e.g., Ziegler *et al.* 2002 [2003], 2010; Hoang *et al.* 2007; Ngo 2008; Ngo *et al.* 2008; Nazarov *et al.* 2008; Bauer *et al.* 2009), it is a troglophile or facultative cavernicole (*sensu* Chapman 1985), often using caves as retreat sites or as sources of prey, but not absolutely dependent on the cave environment.

In addition to the many recently described species of Southeast Asian *Cyrtodactylus*, further undescribed taxa have been identified throughout the region, including from elsewhere in Thailand (Sumontha, pers. observ.). Phylogenetic studies of *Cyrtodactylus* have thus far been limited, but suggest that some taxa occurring in close geographic proximity to one another are also closely related (e.g., Welton *et al.* 2010; Ziegler *et al.* 2010). Our own investigations based on nuclear and mitochondrial DNA (Bauer *et al.*, unpublished) suggest that Thai cave geckos are relatively closely related to one another and that they are part of a larger clade of bent-toed geckos with closer affinities to Malaysian and Indochinese taxa than to those in Myanmar. However, taxa such as *C. erythrops* from Mae Hong Son Province and *C. dumnuii* **sp. nov.** from Chiang Mai Province, both on the Myanmar border, will require careful scrutiny as it is expected that representatives of both the Indochinese and Myanmar radiations of *Cyrtodactylus* could occur in this region.

Like other limestone-dwelling geckos, *C. dumnuii* **sp. nov.** probably has a restricted distribution and should be considered susceptible to localized threats and the evaluation of the conservation status of the new species should be a priority. *Cyrtodactylus* species are often attractive and many have entered the international pet trade (Pauwels *et al.* 2004).

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