Zootaxa 2890: 53–64 (2011)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Gekko canaensis sp. nov. (Squamata: Gekkonidae), a new gecko from Southern Vietnam

NGO VAN TRI[1] & TONY GAMBLE[2]

[1]*Department of Environmental Management and Technology, Institute of Tropical Biology, Vietnamese Academy of Sciences and Technology, 85 Tran Quoc Toan Street, District 3, Hochiminh City, Vietnam. E-mail: trigeckonid@hotmail.com*
[2]*Department of Genetics, Cell Biology and Development, University of Minnesota 6-160 Jackson Hall, 321 Church St SE, Minneapolis MN 55455. USA. E-mail: gambl007@umn.edu*

Abstract

A new species of *Gekko* Laurenti 1768 is described from southern Vietnam. The species is distinguished from its congeners by its moderate size: SVL to maximum 108.5 mm, dorsal pattern of five to seven white vertebral blotches between nape and sacrum and six to seven pairs of short white bars on flanks between limb insertions, 1–4 internasals, 30–32 ventral scale rows between weak ventrolateral folds, 14–18 precloacal pores in males, 10–14 longitudinal rows of smooth dorsal tubercles, 14–16 broad lamellae beneath digit I of pes, 17–19 broad lamellae beneath digit IV of pes, and a single transverse row of enlarged tubercles along the posterior portion of dorsum of each tail segment.

Key words: Cà Ná Cape, description, *Gekko*, *Gekko canaensis* **sp. nov.**, Gekkonidae, granitic outcrop, Vietnam

Introduction

Members of the *Gekko petricolus* Taylor 1962 species group (*sensu* Panitvong *et al.* 2010) are rock-dwelling specialists occurring in southeastern Indochina. The group as currently described consists of eight described species: *Gekko badenii* Szczerbak & Nekrasova 1994; *Gekko grossmanni* Günther 1994; *Gekko lauhachindai* Panitvong *et al.* 2010; *Gekko petricolus* Taylor 1962; *Gekko russelltraini* Ngo *et al.* 2009; *Gekko scientiadventura* Rösler *et al.* 2005; *Gekko takouensis* Ngo & Gamble 2010; and *Gekko vietnamensis* Nguyen 2010. Here we report a new species of large-bodied gecko in the *Gekko petricolus* species group from Cà Ná Cape, an isolated mountain in southern Vietnam.

Material and methods

Field surveys were conducted in May 2006 and June 2010. Voucher specimens were collected by hand during the night. Geographic coordinates and elevation were recorded using a Garmin III GPS. Photographs were taken using a Panasonic DMC–FZ30 digital camera and Sony DCR–TRV22. Specimens were euthanized with tricaine methanesulfonate (MS–222) following Conroy *et al.* (2009), fixed in 10% neutral buffered formalin, rinsed under water and stored in 75% ethanol. Liver samples for use in subsequent DNA sequencing were collected and stored in 95% ethanol and kept in cool conditions. All type specimens are deposited in the Zoological Collection of the University of Natural Sciences (UNS) in Hochiminh City, Vietnam.

The following measurements were taken with a digital caliper following the methods of Bauer (2002, 2003): snout–vent length (SVL); tail length (TailL); head depth (HeadD); head length (HeadL); head width (HeadW); snout to eye distance (SnEye); nare to eye distance (NarEye); orbital diameter (OrbD); ear length (EarL); eye to ear distance (EyeEar); internarial distance (Internar); interorbital distance (shortest distance between left and right supercilliary scale rows) (Interorb); trunk length (TrunkL); crus length (CrusL); forearm length (ForeaL). Values

Accepted by A. Bauer: 21 Apr. 2011; published: 25 May 2011

are reported to the nearest 0.1 mm, but mensural ratios calculated from raw measurements are reported to the nearest 0.01 mm. Measurements and scale counts were taken on right side of animals unless otherwise noted. Scale counts and external observations on morphology were made using an Olympus SZ binocular dissecting microscope. We recorded the following meristic values: number of internasal scales between the supranasals (IntNas); number of chin scales bordering the posterior margin of postmental scales (ChinSc); number scales across the narrowest point of the frontal bone (FrontSc); number of interorbital scale rows (IntOrb); number of supralabials (SupraL); number of infralabials (InfraL); number of dorsal scale rows around midbody (MidBod); number of longitudinal rows of tubercles at midbody (TubRow); number of ventral scales across the belly between the ventrolateral folds at midbody (VentSc); number of subdigital lamellae under digit I of pes (LamPesI); number of subdigital lamellae under digit IV of pes (LamPesIV); number of postcloacal tubercles at tail base (PCT); number of precloacal pores (PrecP); number of middorsal scale rows in the third caudal whorl (Whorl3).

Comparisons were made with material of congeneric species in the Zoological Collection of University of Natural Sciences, as well as original species descriptions and other published faunal and taxonomic treatments (e.g. Taylor 1962; Zhou *et al*. 1982; Grossmann & Ulber 1990; Günther1994; Szczerbak & Nekrasova 1993; Ota *et al*. 1995; Darevsky & Orlov 1994; Rösler *et al*. 2005 & 2010; Bauer *et al*. 2008; Ngo *et al*. 2009; Ngo & Gamble, 2010; Nguyen, 2010; Panitvong *et al.* 2010; and Nguyen *et al*. 2010).

We examined interspecific differences among *G. russelltraini*, *G. takouensis* and the new *Gekko* species from Cà Ná Cape using Principal Components Analysis (PCA) of morphological data. We removed the effect of covariation with SVL by using the residuals of the linear regressions between SVL and morphometric measurements. All statistical analyses were performed in JMP 8.0 (SAS 2007).

Results

Ordination plots of principle components 1 and 2 showed considerable overlap between *G. russelltraini* and *G. canaensis* **sp. nov.** while *G. takouensis* was quite distinct (Figure 1). Ordination plots of principle components 2 and 3 showed all three *Gekko* species as distinct from each other. Principle components 1–3 accounted for 52.4% of the between-group variability in our dataset. Principle component 1 was most strongly loaded among the number of interorbital scales, dorsal tubercle rows, the number of scales across the belly, and residuals from diameter of the orbit and eye/ear distance (Table 1). Principle component 2 was most strongly loaded among residuals of trunk length, forearm length and crus length. Principle component 3 was most strongly loaded by the number of supralabials and SVL.

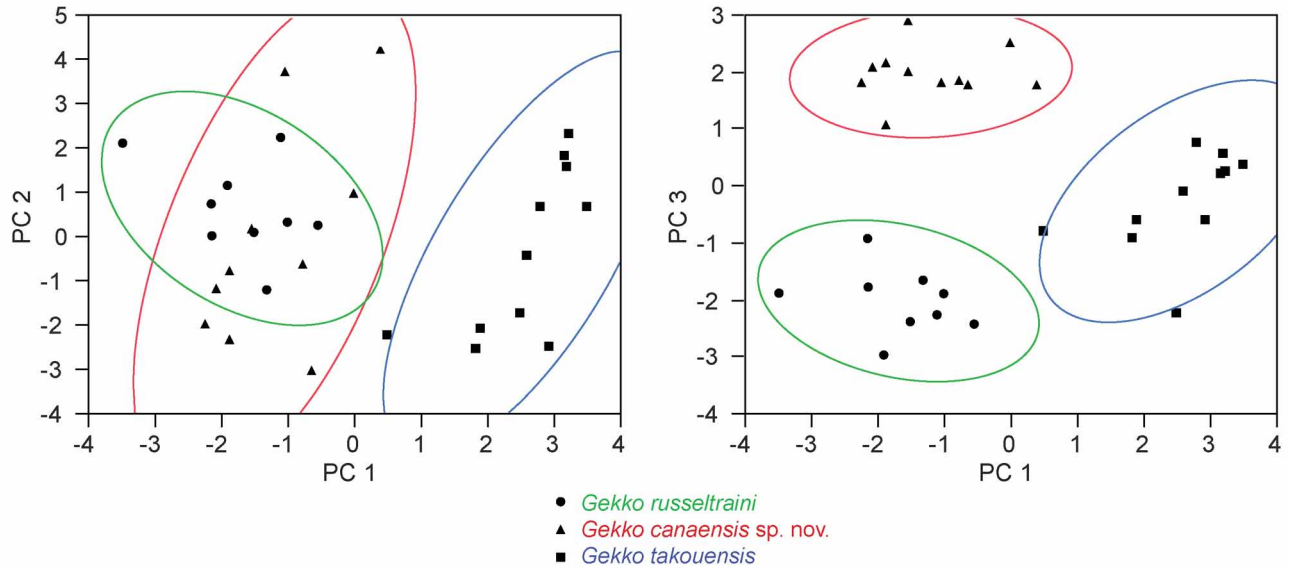

FIGURE 1. Principle component scores for morphological data. Circles represent *Gekko russeltraini*; squares represent *Gekko takouensis*; and triangles represent *Gekko canaensis* **sp. nov.** Colored lines encompases the 95% confidence interval for each species.

TABLE 1. Character loadings (eigenvectors) for the principle component analysis of morphological data.

Variable	PC 1	PC 2	PC 3
SVL	0.20011	-0.09781	0.35135
IntOrb	-0.36965	0.00797	0.11571
SupraL	-0.09347	-0.11652	0.42054
InfraL	-0.16671	0.10676	-0.0245
Midbod	-0.26878	0.2205	-0.25032
TubRow	0.31248	-0.09274	-0.25246
VentSc	0.30994	-0.02361	0.268
LamPesIV	0.23988	0.10098	0.14787
ChinSc	-0.22943	0.09209	-0.3995
Residual HeadL	-0.03296	0.18624	0.22081
Residual HeadW	-0.04452	0.25253	-0.03052
Residual HeadD	-0.13053	0.24579	-0.04321
Residual SnEye	-0.118	0.32551	0.05106
Residual OrbD	-0.30756	0.07533	0.2453
Residual EarL	0.16551	0.19424	0.14549
Residual EyeEar	0.32646	0.13276	-0.27481
Residual Interorb	-0.18235	0.28826	0.15165
Residual Internar	0.18527	0.17558	-0.17909
Residual TrunkL	0.15619	0.42215	0.06624
Residual ForeaL	0.07964	0.36707	0.18525
Residual CrusL	0.22302	0.36907	-0.03489

Systematics

***Gekko canaensis* sp. nov.**
Figures 2–3.

Holotype. Zoological Collection of University of Natural Sciences in Hồ Chí Minh City UNS 0538, adult male (Figure 2A); Cà Ná Cape, Vĩnh Tân commune, Tuy Phong district, Bình Thuận Province, Southern Vietnam, approximately 50 m elevation (Figures 4–5; 11° 20.009”N/108° 52.224”E), collected by Ngô Văn Trí, 21 June 2010.

Paratypes. UNS 0319–24 were collected by N.V.T at the type locality on 26 May 2006. UNS 0539–41 (Figures 2B, 2C), adult males and UNS 0542, adult female, were also collected by Ngô Văn Trí on 22 June 2010 about 2 km south of the type locality.

Etymology. The epithet is derived from the Cà Ná Cape where the type specimens were collected. We suggest the following common names: English — Cà Ná Marbled Gecko and Vietnamese — Thằn lằn đá Cà Ná.

Diagnosis. A medium sized *Gekko* species, maximum SVL 108.5 mm, that can be distinguished from its congeners by the following combination of characteristics: 1–4 internasals; dorsum with 10–14 longitudinal rows of enlarged, smooth dorsal tubercles; 86–93 dorsal scale rows at midbody; 30–32 ventral scale rows at midbody; 14–18 precloacal pores in a angular continuous series in males; 14–16 lamellae on digit I of pes; 17–19 lamellae on digit IV of pes; Dorsal pattern of 5–7 whitish vertebral blotches between nape and sacrum; 6–7 pairs of short, sometimes irregular spots or white bars on flanks between limb insertions; single transverse row of enlarged smooth tubercles along the posterior portion of dorsum of each tail segment.

Description of Holotype. (Figure 2A), UNS 0538, adult male. SVL 108.4 mm. Head relatively long (HeadL/SVL= 0.27) and wide (HeadW/HeadL= 0.66), somewhat depressed (HeadD/HeadL= 0.41), distinct from neck. Loreal and interorbital regions weakly inflated, frontonasal region strongly concave. Snout elongate (SnEye/

HeadL= 0.39), blunt, longer than eye diameter (OrbD/SnEye= 0.60). Scales on snout and forehead small, granular, homogeneous; scales on snout larger than occipital scales except for scattered smooth tubercles (~ 2–3 times size of adjacent scales); 33 interorbital scale rows. Eye large (OrbD/HeadL= 0.23); pupil vertical with crenelated margins when closed and round when opened in maximum; superciliaries smooth, short, bearing several minute conical spines posteriorly. Ear opening obliquely oval, small (EarL/HeadL = 0.10); eye to ear distance longer than diameter of eye (EyeEar/OrbD = 1.20). Rostral quadrangular, wider (3.5 mm) than high (1.7 mm). Supranasals contacted by small internasal (Figure 3A); rostral in contact with supralabial I and supranasals; nostrils round, each surrounded by supranasal, rostral, first supralabial and two enlarged postnasals; 3–5 rows of small scales separate orbit from supralabials. Mental triangular (2.1 mm wide, deep 2.6 mm); anterior pair postmentals elongated (3.1 mm long, 1.2 mm wide), each bordered anteromedially by mental, medially in broad contact with other postmental, bordered anterolaterally by first infralabial, laterally by second postmental, posteriorly by three enlarged chin scales, but the middle largest one (Figure 3B); 16 supralabials on both sides, 13 sublabials on both sides; 23 scale rows on the frontal bone and 33 interorbital scales in the closest distance between two eye edges.

Body robust, relatively short (TrunkL/SVL = 0.46) with weak ventrolateral folds. Dorsal scales smooth, round, granular, juxtaposed; 93 scale rows around midbody, intermixed with enlarged, smooth tubercles (3–4 times size of adjacent scales, smaller on flanks, and smallest in occipital region) extending from occipital region to tail base; tubercles in 14 rows at midbody (Figure 3C). Ventral scales much larger than dorsal scales, smooth, relatively hexagonal, imbricate, gradually larger toward the posterior; 31 scale rows across venter between ventrolateral folds (Figure 3D); gular region with relatively homogeneous, smooth scales. Sixteen precloacal pores arranged in an angular series; scale rows extending posteriorly from pore–bearing scales to anterior of cloacal lip somewhat enlarged (Figure 3F); no enlarged femoral scales. Scales of palms and soles smooth, flattened, round, juxtapose without enlarged tubercles; scales on venter of fore and hind limbs with smooth, flattened, subimbricate scales, slightly enlarged at joints.

Limbs long and relatively robust (ForeaL/SVL = 0.14; CrusL/SVL = 0.16). Digits moderately dilated, all bearing curved claws except the first finger and first toe; number of broad lamellae beneath each digit (15–16–17–18–15 manus; 15–15–19–18–17 pes); two to five narrow lamellar rows between base and digits; interdigital webbing weakly developed. Length of digits (manus; measurement in mm in parentheses): manus: IV(9.2) > III(8.0) > V(7.4) > II(6.8) > I(6.1); (pes): V(10.5) > IV(10.3) > III(10.1) > II(9.5) > I(6.3).

Original tail relatively robust and segmented (Figure 3G), tapering to tip; longer than snout vent length (TailL/SVL= 1.19), two smooth postcloacal tubercles on each side; the first (anterior) being larger than the second (posterior) tubercle. Each tail segment has 3–4 transversely enlarged subcaudal scales and 10 dorsal scales rows. Tail with single transverse row of enlarged smooth tubercles along the posterior portion of dorsum of the first seven tail segments (Figure 3G). Scales of tail dorsum heterogeneous, rectangular to hexagonal, juxtaposed. Subcaudal region with 101 median enlarged transverse plates (Figure 3H).

Coloration. (In preservative) Dorsal color is gray with a series of 5–7 whitish irregular vertebral blotches between the nape and sacrum. The anterior most dorsal blotch is occasionally in contact with a light–colored ring of nuchal spots. Dorsal blotches extend along the tail, becoming ring–like although not fully encircling the tail. Regenerated tail, if present, consists of longitudinal dark stripes on a light background **(**Figure 2C**)**. Six to seven pairs of light–colored, small, irregular bars or spots along the flanks between limb insertions. The dorsum has scattered dark brown or black and whitish flecking. Limbs are colored as dorsum with irregular white or light gray blotches and dark brown to black flecking. Multiple white or light gray, irregular blotches on the head are interspersed with dark brown or black flecks and vermiculations. Two whitish, parallel stripes extend from the rostrum to the eye on each side of the head. One stripe is often incomplete from nare to eye while the other stripe is broken and spotty and runs from the nasals to above the orbit. Light–colored nuchal loop is always broken and irregular. Venter is immaculate and white.

(In life) Dorsal color light to medium gray, with a tan or brown overtone. Limbs colored as dorsum with irregular light blotches and dark speckling. Ventral coloration is yellowish. Iris color is chestnut brown.

Variation. Variation in meristic and mensural characters among the type series are shown in Table 2. There is considerable variation among specimens in the shape and size of dorsal blotches (Figure 2) with some individuals having round or oval shaped blotches (Figure 2A and C) while others have irregular shaped blotches with jagged edges (Figure 2B). Some individuals become lighter at night, a common phenomenon among some gecko species, e.g. *Thecadactylus*, *Hemidactylus* and *Gekko* (Beebe 1944; Chan *et al*. 2006; Vitt *et al*. 2008; Ngo & Gamble, 2010).

TABLE 2. Mensural and meristic data for the type series of *Gekko canaensis* sp. nov. Summary data are provided for males and females separately.

	Holotype	Paratypes								Min – Max, mean ± S.D.	Paratypes		Min – Max, mean ± S.D.
	UNS 0538	UNS 319	UNS 320	UNS 321	UNS 322	UNS 323	UNS 539	UNS 540	UNS 541		UNS 324	UNS 542	
Sex	M	M	M	M	M	M	M	M	M	M (n = 9)	F	F	F (n=2)
SVL	108.5	102.7	100.3	87.5	80.1	88.4	103	104.1	105.9	80.1 – 108.5 97.8 ± 9.9	86.7	90.2	86.7 – 90.2 88.5 ± 2.5
TailL	129.4	108.2 (Reg)	90.6 (Reg)	74.3 (Reg)	90.4	85.5 (Reg)	120.1	99.6 (Reg)	96.4 (Reg)	90.4 – 129.4 (n=3) 113.3 ± 20.4	102.1	108.5	102.1 – 108.5 105.3 ± 4.5
HeadL	29.5	27.2	25.5	23.3	21.2	23.1	27.2	27.1	27.5	21.2 – 29.5 25.7 ± 2.7	22.7	23.9	22.7 – 23.9 23.3 ± 0.9
HeadW	19.5	18.6	18	15.7	14	15.3	19.1	19.2	19.3	14.0 – 19.5 17.6 ± 2.1	14.8	15.4	14.8 – 15.4 15.1 ± 0.4
HeadD	12	11.4	11.3	9.6	8.2	9.1	11.7	11.3	11.6	8.2 – 12.0 10.9 ± 1.4	8.9	8.5	8.5 – 8.9 8.7 ± 0.3
SnEye	11.5	12.1	11.6	10.6	9.8	9.6	11.2	11.3	11.4	9.6 – 12.1 11. 0 ± 0.8	9.4	8.2	8.2 – 9.4 8.8 ± 0.8
NarEye	9.3	9.1	9.2	8.3	8.2	7	8.8	8.8	9	7.0 – 9.3 8.6 ± 0.7	7.1	7.9	7.1 – 7.9 7.5 ± 0.6
OrbD	6.9	6.9	6.8	6.8	6.1	6	6.7	6.7	6.9	6.0 – 6.9 6.6 ± 0.4	6.2	6.2	6.2 6.2 ± 0.0
EarL	2.9	2.8	2.8	2.7	2.6	2.7	2.7	2.8	2.8	2.6 – 2.9 2.8 ± 0.1	2.5	2.7	2.5 – 2.7 2.6 ± 0.1
EyeEar	8.3	8.1	8.2	7	7.1	6.8	7.7	7.7	7.8	6.8 – 8.3 7.6 ± 0.5	6	6.8	6.0 – 6.8 6.4 ± 0.6
Interorb	9.2	9.4	9.5	8.5	7.5	7.8	9.3	9.4	9.6	7.5 – 9.6 8.9 ± 0.8	8.1	7.9	7.9 – 8.1 8.0 ± 0.1

continued next page

TABLE 2. (continued)

	Holotype	Paratypes							Min – Max, mean ± S.D.	Paratypes		Min – Max, mean ± S.D.
	UNS 0538	UNS 319	UNS 320	UNS 321	UNS 322	UNS 323	UNS 539	UNS 540	UNS 541		UNS 324	UNS 542	
Sex	M	M	M	M	M	M	M	M	M	M (n = 9)	F	F	F (n=2)
Internar	2.9	2.4	2.5	2.5	2.4	1.9	2.5	2.6	2.7	1.9 – 2.9 2.5 ± 0.3	1.8	2.3	1.8 – 2.3 2.1 ± 0.4
TrunkL	49.9	46.2	44.5	42.1	39.3	39.5	45.8	46.6	46.7	39.3 – 49.9 44.5 ± 3.5	37.8	38.3	37.8 – 38.3 38.1 ± 0.4
ForeaL	15	13.2	13.1	13.1	12.7	10.9	12.5	13.5	13.6	10.9 – 15.0 13.1 ± 1.1	11	12.2	11.0 – 12.2 11.6 ± 0.8
CrusL	17.4	15.6	15.7	15.2	14.9	13.8	15.5	16.5	16.6	13.8 – 17.4 15.7 ± 1.1	13.7	14.3	13.7 – 14.3 14.0 ± 0.4
IntNas	1	2	2	4	1	2	1	1	1	1 – 4	2	2	2
ChinSc	3	4	3	3	4	3	4	3	4	3 – 4	3	4	3 – 4
FrontSc	23	22	21	19	21	20	22	23	23	19 – 23	20	21	20 – 21
IntOrb	33	32	34	32	34	33	33	32	32	32 – 34	33	32	32 – 33
SupraL	16/16	16/14	16/17	14/15	14/15	17/17	17/17	16/17	15/15	14–17/14–17	15/16	16/15	15–16/15–16
InfraL	13/13	12/11	12/12	12/11	12/12	15/13	12/12	12/12	12/12	12–15/11–13	12/14	11/11	11–12/11–14
Midbod	93	90	91	93	92	90	90	88	92	88 – 93	86	90	86 – 90
TubRow	14	10	12	12	10	12	12	14	12	10 – 14	12	10	10 – 12
VentSc	31	32	30	30	31	30	31	30	30	30 – 32	30	30	30
LamPesI	15	16	16	16	15	14	15	16	15	14 – 16	15	15	15
LamPesIV	19	19	19	17	19	17	18	18	17	17 – 19	18	18	18
PrecP	16	14	16	18	14	16	16	17	15	14 – 18	0	0	0
PCT	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Whorl3	10	10	10	-	10	11	8	11	-	8 – 11	10	10	10

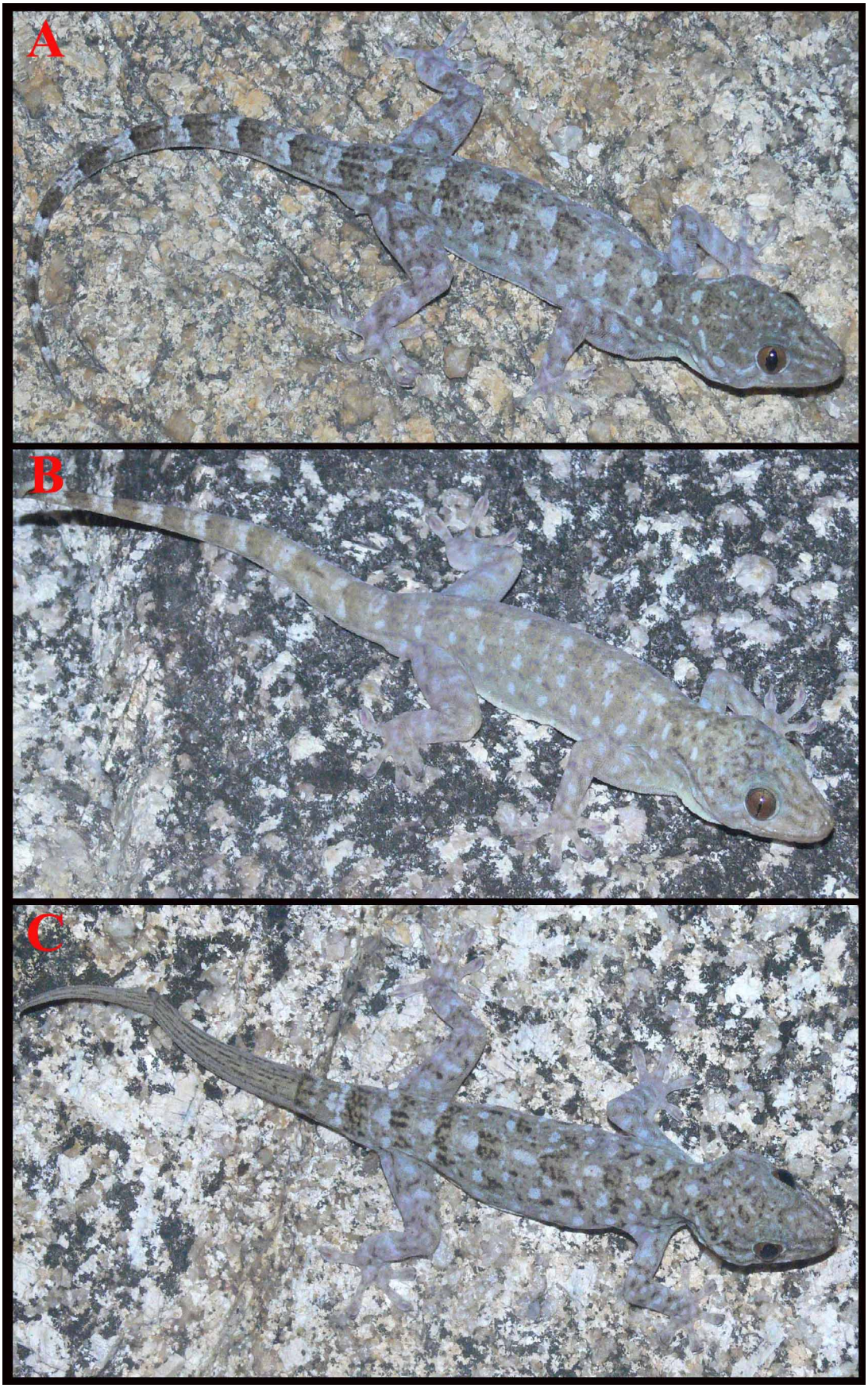

FIGURE 2. *Gekko canaensis* **sp. nov.** A: Holotype UNS 0538 *in situ*; B: paratype UNS 0539 showing a light color; C: paratype UNS 0541 shows a regenerated tail with dark stripes on its tail.

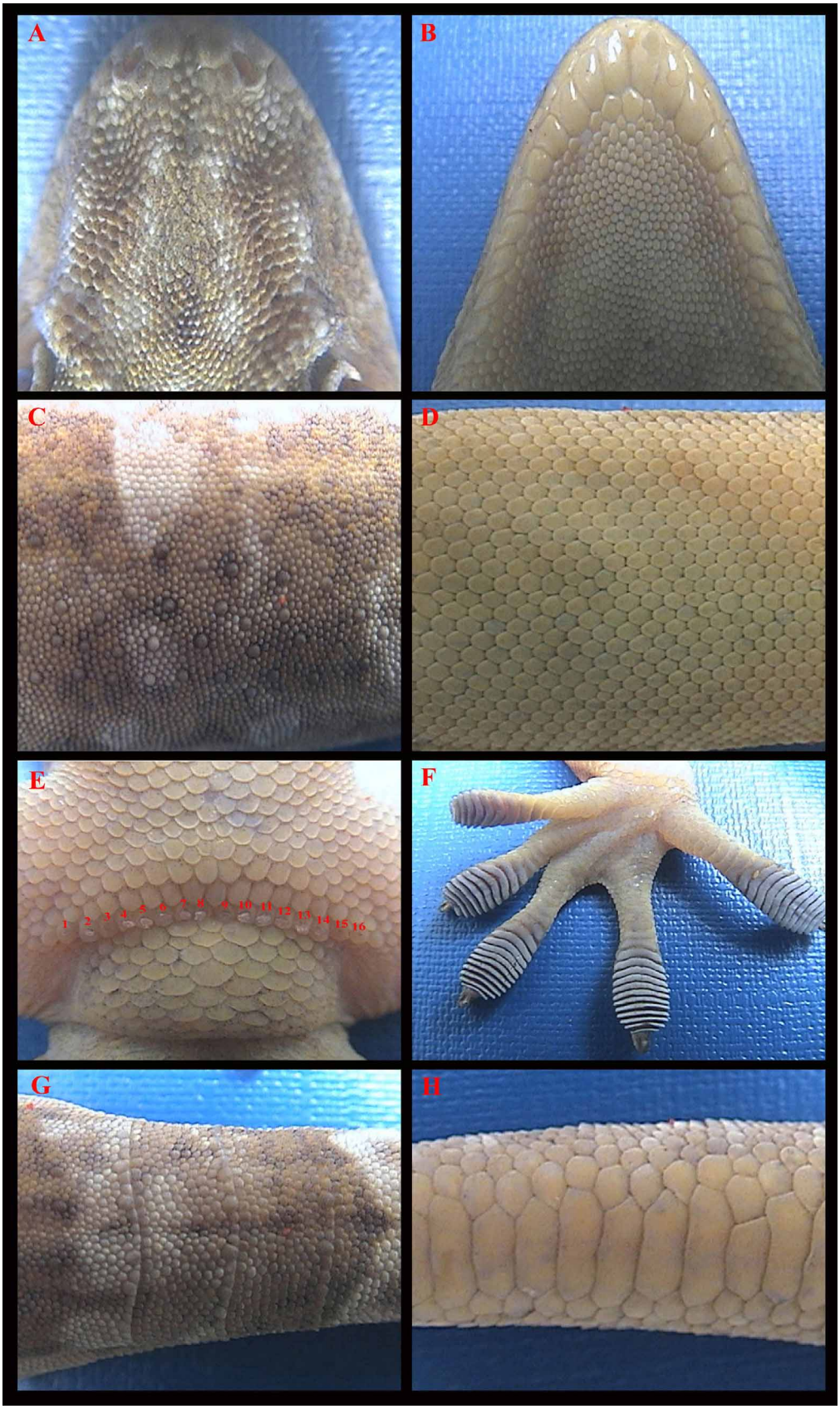

FIGURE 3. *Gekko canaensis* **sp. nov.**, Holotype UNS 0538 A: Rostral with small internasal; B: Mental with three enlarged postmental scales; C: Dorsum with 7 smooth enlarged tubercle rows on middorsum at midbody; D: Subimbricate ventral scales; E: 16 precloacal pores; F: lamellar scales beneath the toes of the right foot; G: tail dorsum segmented smooth tubercles on the first three segments; H: median enlarged subcaudal scales.

FIGURE 4. Landscape of the habitat where *Gekko canaensis* **sp. nov.** occurs.

Natural history. All specimens were collected at night, between 17:30 and 22:00 on the rocky outcropping after a heavy rain. Eggs, two per clutch, were found affixed to the undersides of rocks.

Comparisons. Among its Vietnamese congeners *Gekko canaensis* **sp. nov.** can be distinguished from *G. scientiadventura* by the presence of dorsal tubercles and higher number of precloacal pores (14–18 vs. 5–8); from *G. palmatus* by the lack of broad webbing between the toes; from *G. gecko* by smaller adult SVL (108.5 mm maximum SVL vs. 173 mm maximum SVL – from Rösler *et al*. [2005]) and the rostral borders the nares in *Gekko canaensis* **sp. nov.** but not in *G. gecko*; from *G. badenii* by lack of narrow bands on the dorsum and fewer dorsal scales at midbody (86–93 vs. 114–136); from *G. grossmanni* by larger adult size (89.7–108.5 mm SVL vs. 71.4–89.4 mm SVL), higher number of internasals (1–4 vs. 0–1); higher number of precloacal pores (14–18 vs. 12–14), lower number of dorsal scales at midbody (86–93 vs. 94–115), and higher number of ventral scales at midbody (30–32 vs. 28–30); from *G. russelltraini* by larger adult size (89.7–108.5 mm SVL vs. 70.3–82.9 mm SVL), higher number of precloacal pores (14–18 vs. 8–11), and segmented tail; from *G. canhi* by larger adult size (89.7–108.5 mm SVL vs. 85.8–99.2 mm SVL), higher number of precloacal pores (14–18 vs. 5), smaller of number of ventral scale rows between lateral folds (30–32 vs. 46–50) and fewer interorbital scale rows (32–34 vs. 47–50); from *G. takouensis* by fewer dorsal tubercles at midbody (10–14 vs. 14–17); higher number of precloacal pores (14–18 vs. 11–14), and segmented tail.

Among non-Vietnamese members of the *Gekko petricolus* species group *Gekko canaensis* **sp. nov.** can be distinguished from *G. petricolus* by higher number of precloacal pores (14–18 vs. 9–11) and fewer interorbital scales rows (32–34 vs. 34–41); from *G. lauhachindai* by fewer dorsal scales at midbody (86–93 vs. 112–121), higher number of subdigital scansors under digit IV of pes (17–19 vs. 13–15), and higher number of supralabials (14–17 vs. 11–12).

Discussion. Numerous gecko species have been described from remote mountains and karst outcrops in Southeast Asia in recent years (e.g. Nguyen *et al.* 2006; Ngo & Bauer, 2008; Grismer *et al.* 2008; Grismer 2010; Ziegler & Nguyen 2010). The discovery of another new *Gekko* species on an isolated mountain in southern Vietnam highlights the importance of mountainous regions as centers of biodiversity in the tropics as well as the importance of continuing biological surveys in the region. The known distribution of *Gekko canaensis* **sp. nov.** is disjunct from other described members of the *Gekko petricolus* species group (*sensu* Panitvong *et al*. 2010, Figure 5). Cà Ná Cape is about 110km northeast of Tà Kóu Mountain in Binh Thuan Province, where *G. takouensis* occurs and approximately 60 km south of Nui Chua National Park, Ninh Thuan province, the southernmost known population of *G. grossmanni* (Ngo & Ziegler, 2009). The abundance of isolated mountains and karst throughout the region, coupled with large areas that have yet to be surveyed by herpetologists, suggests there are many gecko species waiting to be described.

FIGURE 5. Map of Southeast Asia indicating the type localities of all described members of the *Gekko petricolus* species group. The type locality of *Gekko canaensis* **sp. nov.**, in Ninh Thuan province is indicated by a filled circle.

Gekko canaensis **sp. nov.** is quite likely the "large-bodied *Gekko grossmanni* depicted by Kober (2004). *Gekko canaensis* **sp. nov.** is the only member of the *G. petricolus* group that has all of the characteristics described or illustrated by Kober (2004): large body size (260 mm total length); 16–18 precloacal pores; two cloacal spurs on either side of the base of the tail; round or oval shaped blotches on the sides of the body; 15–16 supralabaials; and light-colored, patternless ventral scales. Kober's (2004) paper provides a good overview of the captive husbandry and reproduction of *Gekko canaensis* **sp. nov.**

Conservation status. The presumably limited distribution of *Gekko canaensis* **sp. nov.** makes it particularly vulnerable to overharvest and habitat destruction. Cà Ná Cape is an unprotected area in Binh Thuan province and very little original forest remains in the region. Large numbers of trees have been removed to make charcoal and smaller trees have been sold to nurseries for ornamental use. Vegetation has also been reduced and damaged by cattle grazing. Granite quarrying has caused substantial damage to rock outcrops. *Gekko canaensis* **sp. nov.** has also been heavily exploited for the international pet trade. Kober's (2004) paper confirms that commercial harvest and export for the pet trade have been occurring for most of the last decade. Talking with gecko trappers, the price of each gecko is about 5,000–7,000 VND ($0.25–0.35 USD). *Gekko canaensis* **sp. nov.** was very abundant during the

first survey in 2006, but far fewer individuals were observed in the 2010 survey. It is likely that harvest for meat and the pet trade along with habitat destruction have been responsible for these declines. *Gekko canaensis* **sp. nov.** should be considered for listing in the Red Databook of Vietnam and IUCN Redlist of Threatened Species given observed declines in abundance, the long history of commercial exploitation and ongoing habitat destruction. Additional surveys and monitoring should be conducted to determine the total distribution of *Gekko canaensis* **sp. nov.** and help detect any further declines at the type locality.

Acknowledgements

We thank Dr. Hoang Nghia Son and Dr. Vu Ngoc Long, Board Director of the Institute of Tropical Biology, Vietnamese Academy of Sciences and Technology for permission to conduct this research. A. Bauer and two anonymous reviewers provided useful comments. We thank Dr. Hoang Duc Huy (Faculty of Biology of the University of Natural Sciences in Hochiminh City) and prof. Hoang Duc Dat (post head of Department of Ecology and Development, Institute of Tropical Biology). We would also like to thank prof. L.L. Grismer for providing MS–222.

References

Bauer, A.M. (2002) Two new species of *Cyrtodactylus* (Squamata: Gekkonidae) from Myanmar. *Proceedings of the California Academy of Sciences*, 53, 75–88.

Bauer, A.M. (2003) Descriptions of seven new *Cyrtodactylus* (Squamata: Gekkonidae) with a key to the species of Myanmar (Burma). *Proceedings of the California Academy of Sciences*, 54, 463–498.

Bauer, A.M., Sumontha, M. & Pauwels, O.S.G. (2008) A new red–eyed *Gekko* (Reptilia: Gekkonidae) from Kanchanaburi province, Thailand. *Zootaxa*, 1750, 32–42.

Beebe, W. (1944) Field notes on the lizards of Kartabo, British Guiana, and Caripito, Venezuela. Part 1. Gekkonidae. *Zoologica (NY)* 29, 145–160.

Chan, S.K.F., Cheung, K., Ho, C., Lam, F. & Tang, W. (2006) The geckos of Hong Kong. *Hong Kong Biodiversity*, 13, 1–9.

Conroy, C.J., Papenfuss, T., Parker, J. & Hahn, N.E. (2009) Use of tricaine methanesulfonate (MS–222) for euthanasia of reptiles. *Journal of the American Association for Laboratory Animal Science*, 48, 28–32.

Darevsky, I.S. & Orlov, N.L. (1994) Eine bemerkenswerte neue, großwüchsige Art der Gattung *Gekko*: *Gekko ulikovskii* sp. nov. aus Zentralvietnam. *Salamandra*, 30, 71–75.

Grismer, L.L. (2010) The first record of the genus *Cnemaspis* Strauch (Squamata: Gekkonidae) from Laos with the description of a new species. *Zootaxa*, 2475, 55–63.

Grismer, L.L., Grismer, J.L., Wood, Jr., P.L. & Chan, K.O. (2008) The distribution, taxonomy, and redescription of the geckos *Cnemaspis affinis* (Stoliczka 1887) and *C. flavolineata* (Nicholls 1949) with descriptions of a new montane species and two new lowland, karst-dwelling species from Peninsular Malaysia. *Zootaxa*, 1931, 1–24.

Grossmann, W. & Ulber, T. (1990) Ein neuer Gecko aus Zentral–Thailand: *Gekko siamensis* sp. nov. (Reptilia: Sauria: Gekkonidae). *Sauria*, 12(3), 9–18.

Günther, R. (1994) A new species of the genus *Gekko* (Reptila, Squamata, Gekkonidae) from southern Vietnam. *Zoologische Anzeiger*, 233, 57–67.

Kober, I. (2004) Haltung und kontinuierliche Nachzucht des Marmorgeckos, *Gekko grossmanni* Günther, 1994. *Salamandra*, 40, 261–280.

Ngo, V.T. & Bauer, A.M. (2008) Descriptions of two new species of *Cyrtodactylus* Gray, 1827 (Squamata: Gekkonidae) endemic to southern Vietnam. *Zootaxa*, 1715, 27–42.

Ngo, V.T & Ziegler, T. (2009) A new species of *Dixonius* from Nui Chua National Park, Ninh Thuan Province, southern Vietnam (Squamata, Gekkonidae). *Zoosystematics and Evolution*, 85, 117–125.

Ngo, V.T., Bauer, A.M., Wood Jr. P.L. & Grismer, J.L. (2009) A new species of *Gekko* Laurenti, 1768 (Squamata: Gekkonidae) from Dong Nai Province, Southeastern Vietnam. *Zootaxa*, 2238, 33–42.

Ngo, V.T. & Gamble, T. (2010) A new species of *Gekko* (Squamata: Gekkonidae) from T Kóu Nature Reserve, Binh Thuan Province, Southern Vietnam. *Zootaxa*, 2346, 17–28.

Nguyen, N.S. (2010) A new poreless species of *Gekko* Laurenti, 1768 (Gekkonidae: Squamata) from An Giang Province, southern Vietnam. *Zootaxa*, 2501, 54–60.

Nguyen, N.S., Orlov, N.L. & Darezsky, I.S. (2006) Descriptions of two new *Cyrtodactylus* Gray, 1827 (Squamata: Sauria: Gekkonidae) from Southern Vietnam. *Russian Journal of Herpetology*, 13, 215–226.

Nguyen, Q.T., Schmitz, A. & Böhme, W. (2010) *Gekko ulikovskii* Darevsky & Orlov, 1994: a junior synonym of *Gekko badenii* Szczerbak & Nekrasova, 1994. *Bonn Zoological Bulletin*, 57, 15–17.

Ota, H., Lau, M.W., Weidenhöfer, T., Yasukawa, Y. & Bogadek, A. (1995) Taxonomic review of the geckos allied to *Gekko*

chinensis Gray, 1842 (Gekkonidae: Reptilia) from China and Vietnam. *Tropical Zoology*, 8, 181–196.
Panitvong, N., Sumontha, M., Konlek, K. & Kunya, K. (2010) *Gekko lauhachindai* sp. nov., a new cave-dwelling gecko (Reptilia: Gekkonidae) from central Thailand. *Zootaxa*, 2671, 40–52.
Rösler, H., Ziegler, T., Vu, N.T., Herrmann, H.W. & Böhme, W. (2005) A new lizard of the Genus *Gekko* Laurenti, 1768 (Squamata: Sauria: Gekkonidae) from the Phong Nha - Ke Bang National Park, Quang Binh province, Vietnam. *Bonner Zoologische Beiträge*, 53, 135–148.
Rösler, H., Nguyen, Q.T., Doan, V.K., Ho, T.C., Nguyen, T.T. & Ziegler, T. (2010) A new species of the genus *Gekko* Laurenti (Squamata: Sauria: Gekkonidae) from Vietnam with remarks on *G. japonicus* (Schlegel). *Zootaxa*, 2329, 56–68.
SAS (2007) *JMP.* SAS Institute Inc, Cary, North Carolina, USA.
Szczerbak, N.N. & Nekrasova, O.D. (1994) A contribution to the knowledge of gekkonid lizards of southern Vietnam with description of a new species (Reptilia, Gekkonidae). *Vestnik Zoologii*, 1994, 48–52. [in Russian].
Taylor, E.H. (1962) New Oriental reptiles. *University of Kansas Science Bulletin*, 43, 209–263.
Vitt, L., Magnusson, E.E., Pires, T.C.A. & Lima, A.P. (2008) Guia de Lagartos da Reserva Adolpho Ducke, Amazônia Central. Áttema Design Editorial, Manaus. 176 pp.
Ziegler, T. & Nguyen, Q.T. (2010) New discoveries of amphibians and reptiles from Vietnam. *Bonn Zoological Bulletin*, 57, 137–147.
Zhou, K.Y., Liu, Y.Z. & Li, D.J. (1982) Three new species of *Gekko* and remarks on *Gekko hokouensis* (Lacertiformes, Gekkonidae). *Acta Zootaxonomica Sinica*, 7, 438–446, pls. 1–2. [English translation by Ota, H., Hikida, T. & Lue, K. (1989) *Smithsonian Herpetological Information Service*, 77, 1–10, 2 pls.].