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A new sandstone-dwelling leaf-toed gecko (Gekkonidae: *Dixonius mekongensis*) from the Thai-Lao border

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Abstract

We describe *Dixonius mekongensis* **sp. nov.** from sandstone formations in Khong Chiam District, Ubon Ratchathani Province, in extreme eastern Thailand along the Laotian border. The new species differs from all currently recognized *Dixonius* by the following combination of morphological characters and pattern: maximal known snout-vent length of 51.2 mm; 16 longitudinal rows of dorsal tubercles; 32 to 34 paravertebral scales; 22 to 24 longitudinal rows of ventral scales across the abdomen; seven precloacal pores in males, no pores in females; a marked canthal stripe; and a spotted to uniform dorsal pattern. This description brings the number of *Dixonius* species to 13, with six species endemic to Thailand.

Key words: Mekong River, Isan, *Dixonius mekongensis* **sp. nov.**, taxonomy

Introduction

At the time of its establishment in 1997, only two species were allocated to the genus *Dixonius* Bauer, Good & Branch. Since then, not less than ten additional species were described, multiplying by six its previously recognized diversity. The actual number of species is probably much higher. Several taxa currently regarded as synonyms should be re-evaluated; the presumably widespread *Dixonius siamensis* (Boulenger, 1898), type-species of the genus, is certainly a complex of superficially-similar species, and many limestone formations seem to house unique and distinctive species (Pauwels *et al*. 2020; Sumontha & Pauwels 2020). Since two decades our team is exploring isolated geological formations and "habitat islands" in all regions of Thailand in order to inventory their associated herpetofauna, with an emphasis on *Dixonius* and other geckos. A visit in 2009 to one of the most beautiful landscapes in the country, in Khong Chiam District of Ubon Ratchathani Province on the border with Laos, revealed another unique *Dixonius* species strictly associated with sandstone formations. Its possession of, among others, a single pair of enlarged terminal scansors, a tuberculate dorsal scalation with longitudinal keels on the tubercles, a rostral scale with a median cleft, first supralabials in contact with the nostril, enlarged chinshields and lateral gulars, precloacal pores and cloacal spurs present, a median row of transversely enlarged caudal scales, and the absence of terminal scansorial pad on tail, make it an obvious member of the genus *Dixonius* (see diagnosis in Bauer *et al*. 1997), but it shows a unique combination of morphological and chromatic characters, and is consequently described here as new.

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Material and methods

Voucher specimens were fixed in 90% ethanol and subsequently transferred into 70% ethanol for permanent storage. Measurements and meristic counts followed Sumontha & Pauwels (2020) and Pauwels *et al*. (2020). Paired meristic characters are given left/right. Numbers of supralabial and infralabial scales were counted from the largest scale immediately posterior to the dorsal inflection of the posterior portion of the upper jaw to the rostral and mental scales, respectively. The number of longitudinal rows of body tubercles was counted transversely across the center of the dorsum. The number of longitudinal rows of ventral scales was counted transversely across the center of the abdomen between the lowest rows of dorsal tubercles. The numbers of subdigital lamellae beneath the toes were counted from the distal one containing claw (claw not counted) to the basal one that broadly contacts the adjacent fragmented scales (claw fragmented scales not counted). The sex of the types and other photographed individuals was determined based on the presence or absence of precloacal pores and hemipenial swellings.

The following measurements were taken with a digital caliper to the nearest 0.1 mm: BW: Body width, greatest width of torso, taken at level of midbody; EarL: ear length, the greatest horizontal distance of the ear opening; FAL: forearm length, taken on the dorsal surface from the posterior margin of the elbow while flexed 90° to the inflection of the flexed wrist; HD: head depth, the maximum depth of head from the occiput to the throat; HL: head length, from the posterior margin of the retroarticular process of the lower jaw to the tip of the snout; HW: head width, measured at the angle of the jaws; InterN: internarial distance, measured between the nares across the rostrum; InterOrb: interorbital distance, measured between the anterior edges of the orbits; NosOrb: nostril to orbit distance, from the posterior margin of the external nares to the anterior margin of the orbit; OrbD: orbit diameter, the greatest horizontal diameter of the orbit; OrbEar: orbit to ear distance, from the anterior edge of the ear opening to the posterior edge of the orbit; SnOrb: snout to eye distance, from the tip of the snout to the anteriormost margin of the orbit; SVL: snout-vent length, taken from the tip of snout to the vent; TailL: tail length, taken from the vent to the tip of the tail, original or regenerated; TailW: tail width, taken at the base of the tail immediately posterior to the postcloacal swelling; TibL: tibia length, taken on the ventral surface from the posterior surface of the knee while flexed 90° to the base of heel; TrunkL: axilla to groin length (trunk length), taken from the posterior margin of the forelimb at its insertion point on the body to the anterior margin of the hind limb at its insertion point on the body. Meristic characters abbreviations: DTR: longitudinal rows of dorsal tubercles; FemPo: femoral pores; ICS: interciliary scales, counted between supraciliaries at midpoint of orbit; IL: infralabial scales; InterOrbS: interorbital scales, counted across the narrowest point of the frontal bone; PrePo: precloacal pores; PV: paravertebral scales, number of scales in a paravertebral row from first scale posterior to parietal scale to last scale at the level of vent opening; PV': paravertebral scales in a row between limb insertions; SL: supralabial scales; SLMOrb: number of supralabial scales at mid-orbital position; SubLT4: number of subdigital lamellae beneath 4th toe; Ven: ventral scales.

Comparisons were made using the original descriptions of all currently recognized *Dixonius* species and their synonyms, as well as other publications containing original data (Boulenger 1898; Mocquard 1904; Annandale 1905a-b; Taylor 1962, 1963; Grossmann *et al*. 1996; Bauer *et al*. 2004; Das 2004; Ngo & Ziegler 2009; Botov *et al*. 2015; Ziegler *et al*. 2016; Sumontha *et al*. 2017; Nguyen *et al*. 2020, 2021; Pauwels *et al*. 2020; Sumontha & Pauwels 2020; and references therein) and museum preserved specimens (see Appendix).

Museum and other acronyms: AUP: Agriculture University of Phayao, Phayao; CUMZ-R: Chulalongkorn University Museum of Zoology, Reptile Collection, Bangkok; MNHN: Muséum national d'Histoire naturelle, Paris; MS: Montri Sumontha's field number series; PSUZC, Prince of Songkhla University Zoological Collection, Songkhla; RBINS: Royal Belgian Institute of Natural Sciences, Brussels; THNHM: Thailand Natural History Museum, National Science Museum, Technopolis, Pathum Thani; and ZMKU Rep: Zoological Museum of Kasetsart University, Reptile Collection, Bangkok.

Systematics

***Dixonius mekongensis* sp. nov.**
(Figures 1–5)

Holotype. AUP 02007 (field no. MS 561), adult male caught on 2 July 2009 on a sandstone platform (ca. 15°27'19.1"N,

105°34’12.0”E) by T. Kaewmanee, Na Pho Klang Sub-district, Khong Chiam District, Ubon Ratchathani Province, eastern Thailand.

FIGURE 1. Live adult male holotype of *Dixonius mekongensis* **sp. nov.** Photo. by M. Sumontha.

FIGURE 2. Preserved male holotype of *Dixonius mekongensis* **sp. nov. A.** Right profile of the head. **B.** Dorsal surface of the head. **C.** Ventral surface the head. **D.** Cloacal area, showing the precloacal pores. Photos. by M. Sumontha.

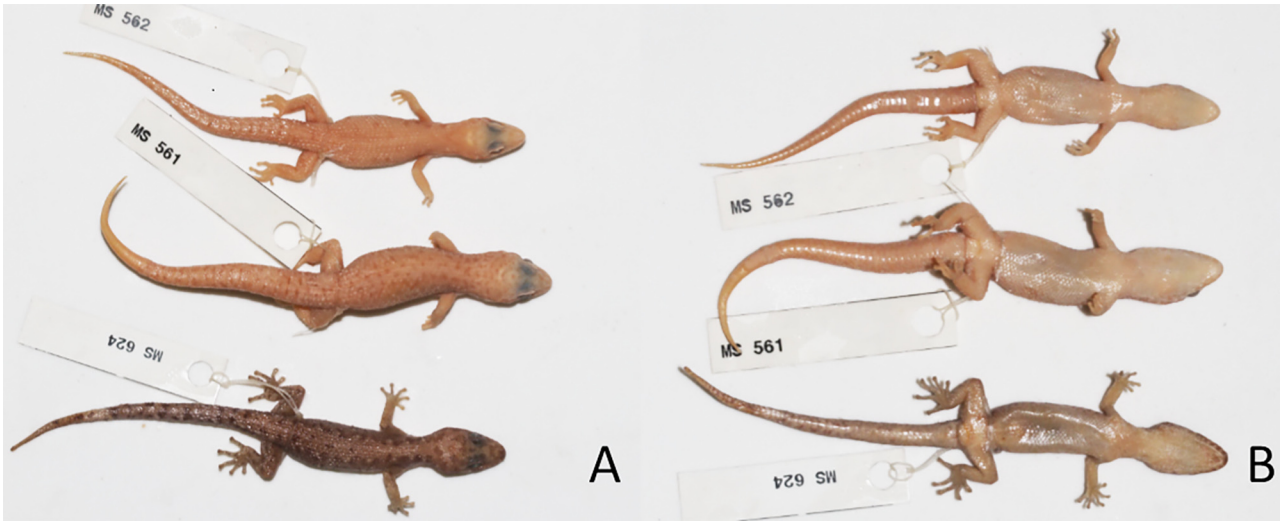

FIGURE 3. Preserved type-series of *Dixonius mekongensis* sp. nov. A. Dorsal view. B. Ventral view. (MS 561 = male holotype AUP 02007; MS 562 = female paratype AUP 02008; MS 624 = male paratype PSUZC-R 736). Photos. by M. Sumontha.

FIGURE 4. Live adult female paratype (AUP 02008) of *Dixonius mekongensis* **sp. nov.** Photo. by M. Sumontha.

Paratypes (2). PSUZC-R 736 (field no. MS 624), adult male, and AUP 02008 (field no. MS 562), adult female. Same locality, collecting date and collector as holotype.

Diagnosis. *Dixonius mekongensis* **sp. nov.** can be distinguished from all other congeneric species by the combination of its maximal known SVL of 51.2 mm; 16 longitudinal rows of dorsal tubercles; 32 to 34 paravertebral scales; 22 to 24 longitudinal rows of ventrals across the abdomen; seven precloacal pores in males, no pores in females; a marked canthal stripe; and a uniform or spotted dorsal pattern.

Description of holotype. Adult male (Figures 1–3). SVL 48.6 mm. Head relatively long (HL/SVL ratio 0.32), wide (HW/HL ratio 0.67), not markedly depressed (HD/HL ratio 0.44), distinct from neck. Lores and interorbital region weakly inflated. Canthus rostralis relatively prominent. Snout moderately short (SnOrb/HL ratio 0.36), rounded, slightly longer than orbit diameter (OrbD/SnOrb ratio 0.61). Scales on snout and forehead small, hexagonal to rounded, flattened, with smooth or slightly rugose surface. Scales on snout larger than those on occipital region. Eye of moderate size (OrbD/HL ratio 0.22). Pupil vertical with crenelated margins. Supraciliaries short, without spines. Ear opening oval, moderate (EarL/HL ratio 0.06); orbit to ear distance greater than orbit diameter. Rostral about twice wider than high, dorsally incompletely divided by a median cleft. Two enlarged supranasals in broad contact. Rostral in contact with supralabial I on each side, nostrils and both supranasals. Nostrils round, each surrounded by supranasal, rostral, supralabial I and two postnasals. Mental triangular, about as long as deep. Two pairs of enlarged postmentals, anteriormost approximately four times larger than posterior. Each anterior postmental bordered anteriorly by mental, medially by the other anterior postmental, anterolaterally by infralabial I, posterolaterally by the second postmental; the pair collectively bordered posteromedially by a row of six throat scales. Supralabials to mid-orbital position 7/6; enlarged supralabials to angle of jaws 8/9. Infralabials 6/7. Interorbital scales eight.

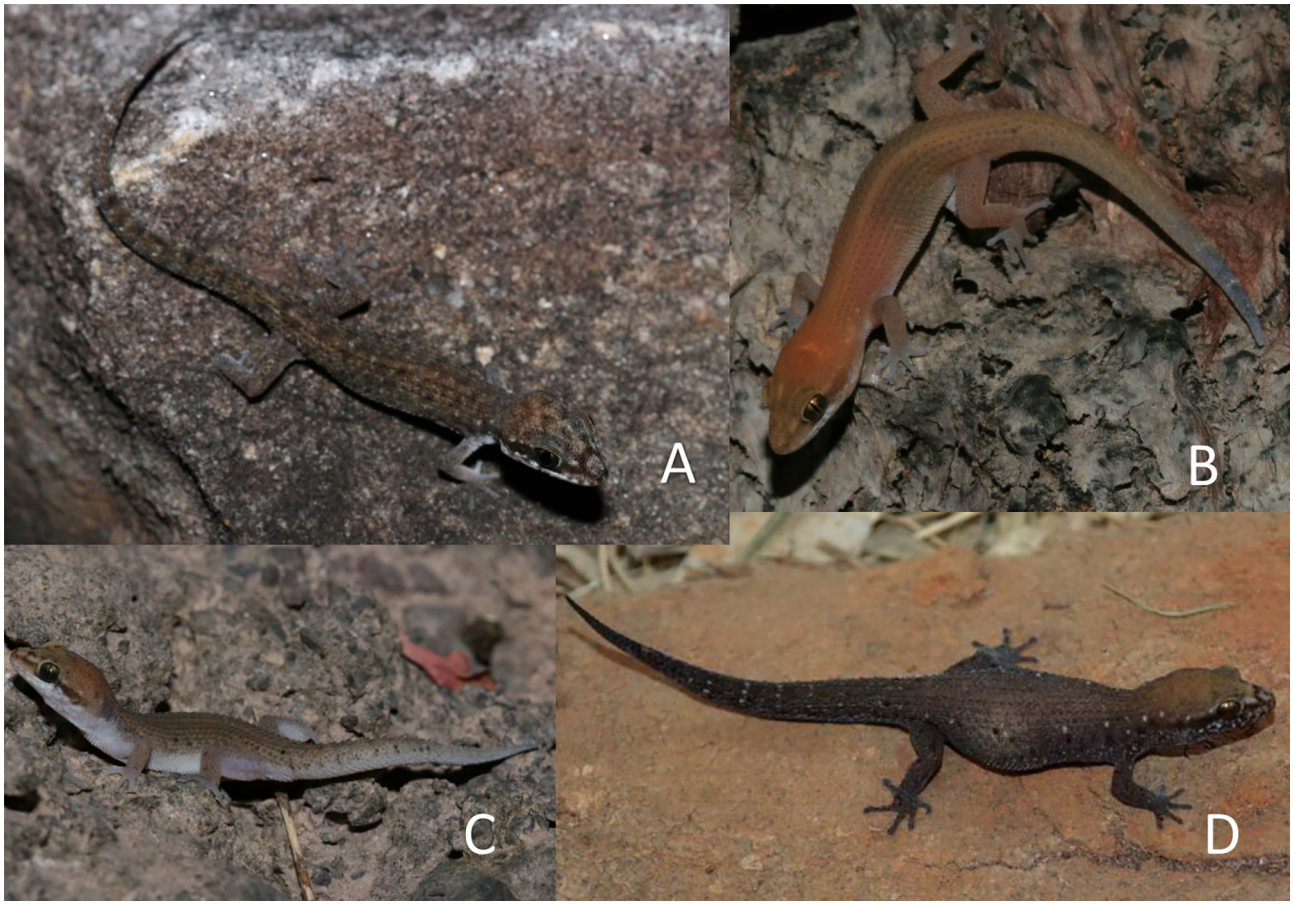

FIGURE 5. Live adult individuals of *Dixonius mekongensis* **sp. nov.**, uncollected, from Pha Taem National Park, Ubon Ratchathani Province, eastern Thailand. **A.** Male. Photo. by B. Siriphiphat. **B.** Adult female. Photo. by N. Panitvong. **C.** Adult female. Photo. by B. Siriphiphat. **D.** Adult pregnant female. Photo. by K. Kunya.

Body slender, elongate (TrunkL/SVL ratio 0.44), without ventrolateral folds. Dorsal scales heterogeneous, small, irregular, flattened to conical, distributed among large, strongly keeled tubercles arranged in 16 regular

longitudinal rows at midbody. Flanks covered with irregular, smooth to slightly conical scales. Gular region with relatively homogeneous, granular scales. Ventral scales smooth, imbricate, their free margin rounded. Ventrals increasing in size from throat to chest to abdomen. Midbody scale rows across belly to lowest rows of tubercles 24. Seven precloacal pores in a continuous series. Pore-bearing scales not enlarged relative to adjacent scale rows. No femoral pores or enlarged femoral scales.

Fore- and hind limbs short, slender (FAL/SVL ratio 0.14; TibL/SVL ratio 0.15). Digits slender, dilated distally, all bearing robust, slightly recurved claws. Basal subdigital lamellae narrow, without scansorial surfaces (6-8-10-11-10 right manus; 12-15-14-8-7 right pes); setae-bearing lamellae restricted to enlarged, distal, ''leaf-like'' scansors. Scales on palm and sole small, smooth, rounded to oval. Interdigital webbing absent. Relative length of digits: III>IV>V>II>I (manus), IV>V>III>II>I (pes). Tail length 60.8 mm of which the last 23.7 mm are regenerated. Supracaudals markedly keeled in the anterior portion of the tail. Ventral tail scales of the original portion of the tail enlarged into transverse plates.

TABLE 1. Meristic and morphometric (in mm) data for the type series of *Dixonius mekongensis* **sp. nov.** Paired meristic characters are given left/right.

	Holotype, AUP 02007	Paratype, PSUZC-R 736	Paratype, AUP 02008
Sex	Male	Male	Female
SVL	48.6	51.2	45.9
TailL	60.8*	52.7*	53.8
TrunkL	21.2	21.6	19.9
TailW	6.8	5.2	5.0
BW	11.3	9.0	10.5
HL	15.6	15.4	14.3
HW	10.5	9.1	8.4
HD	6.9	6.0	4.9
EarL	0.9	1.0	0.8
TibL	7.1	6.7	6.6
FAL	6.6	6.1	5.6
OrbD	3.4	3.6	3.0
NosOrb	4.1	3.6	3.8
SnOrb	5.6	5.2	4.9
OrbEar	4.8	4.4	3.6
InterN	2.2	2.2	1.7
InterOrb	2.2	2.2	2.2
Ven	24	22	22
DTR	16	16	16
PV	32	34	32
PV'	22	24	20
SubLT4	14/14	15/15	12/12
InterOrbS	8	9	8
ICS	25	26	27
SL	8/9	8/9	9/7
IL	6/7	7/7	6/6
SLMOrb	7/6	7/7	6/5
PrePo	7	7	0
FemPo	0/0	0/0	0/0

*partly regenerated.

TABLE 2. Comparison of selected diagnostic characters of *Dixonius* spp. Ba = banded; Bl = blotched; Sp = spotted; St = striped; U = uniform. NA = not available. Bolded values are diagnostic differences from *Dixonius mekongensis* **sp. nov**.

Character	*D. aaronbaueri*	*D. dulayaphitakorum*	*D. hangseesom*	*D. kaweesaki*	*D. lao*	*D. mekongensis* **sp. nov.**	*D. melanostictus*	*D. minhlei*	*D. pawangkhananti*	*D. siamensis*	*D. somchanhae*	*D. taoi*	*D. vietnamensis*
Max. SVL	**38.6**	47.8	**42.1**	**41.6**	55.4	51.2	50.0	47.5	**42.6**	**57.0**	47.1	**43.9**	**42.4**
Ven	**18–19**	22	22–26	24	23–24	22–24	22	20–23	**16**	18–25	23–26	21–23	**15–21**
DTR	**11**	**22**	**12–14**	**12–13**	**20–23**	16	**10–11**	**14–15**	16	**10–14**	**19–21**	**11–12**	13–17
PV	**45–50**	33–35	NA	NA	**40–43**	32–34	NA	**38–44**	30–32	NA	**35–40**	31–42	36
PV	**29–32**	20–25	NA	NA	24–25	20–24	NA	23–26	18–21	NA	19–27	18–25	NA
SubLT4	13–15	12–15	NA	15	15	12–15	15	12–15	14–15	12–16	13–15	12–14	12–15
InterOrbS	8–10	9–10	**10**	**6–7**	8–9	8–9	NA	7–10	**7**	NA	7–8	7–10	8–10
SL	8–9	8	8	**10–11**	8–10	7–9	9	7–9	7–8	7–8	7–8	7–8	7
SLMOrb	6–7	6	6	7–8	7–8	5–7	7	5–6	5–6	NA	6–7	5–6	5–6
IL	6–8	7	8	6–8	7–8	6–8	7	6–7	6–7	6–7	5–6	5–7	6–7
PrePo	**5**	6–7	6–8	**9–11**	**8**	7	**9**	7–8	**6**	6–7	**5–6**	**5–6**	5–7
FemPo	0	0	0	0	0	0	0	0	0	0	0	0	0
Marked canthal stripe	1	**0**	1	1	**0**	1	1	1	1	**0**	1	1	1
Dorsal pattern	U	Sp	**Ba / Bl**	**St**	U	U / Sp	**St**	Sp	**Ba / Bl**	Sp	Sp	**Bl**	Sp

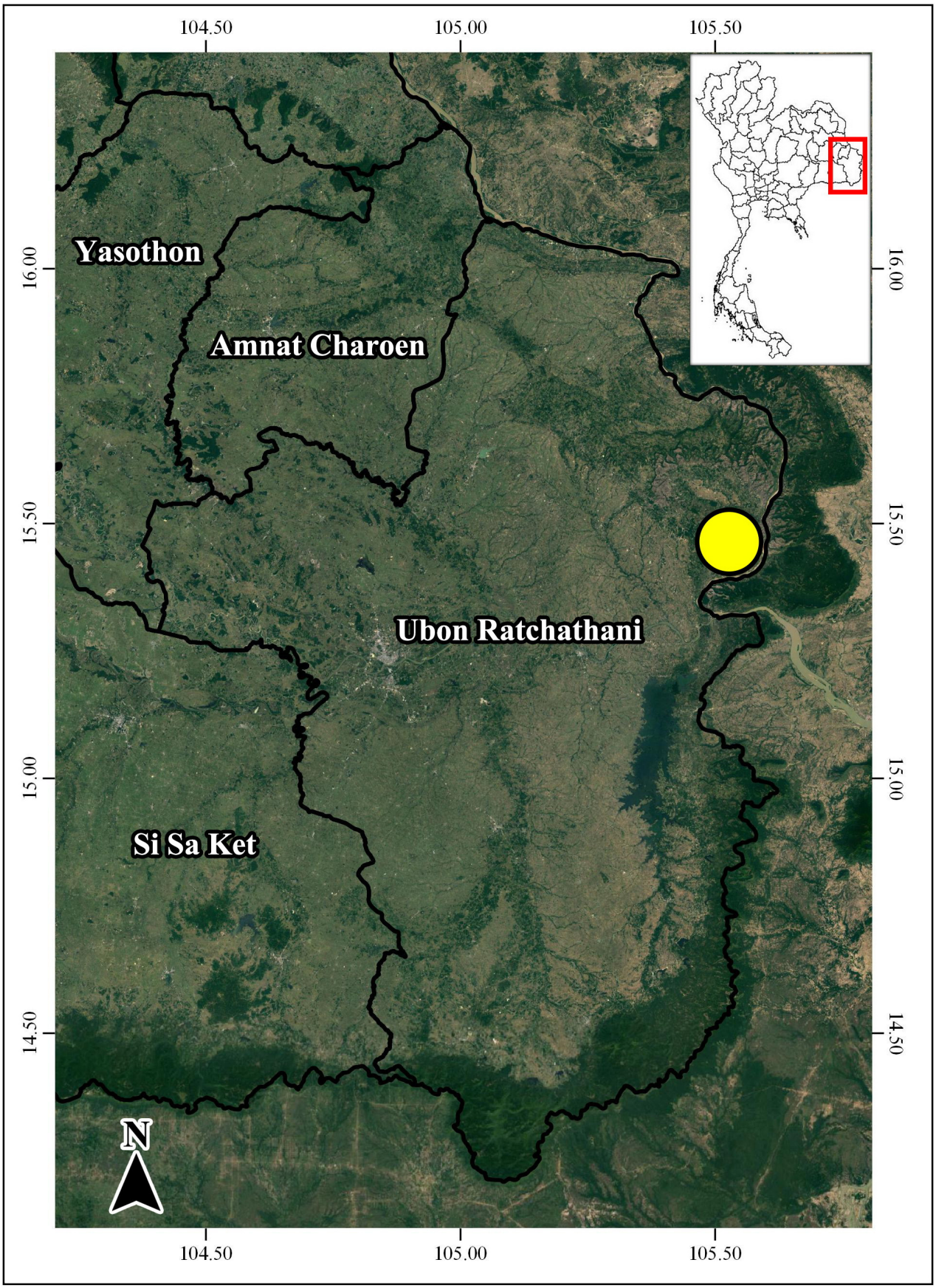

FIGURE 6. Map showing the position of the type-locality of *Dixonius mekongensis* **sp. nov.** in Ubon Ratchathani Province, eastern Thailand. Map by W. Sodoab.

FIGURE 7. Biotope of *Dixonius mekongensis* **sp. nov.** at Soi Sawan Waterfall in Pha Taem National Park, Ubon Ratchathani Province, eastern Thailand. Photo. by M. Sumontha.

Coloration in life. Dorsal surface of head gray with numerous small and irregular black blotches. On each side of the head a black canthal stripe runs from the nostril through the eye and extends to the ear; it is bordered below and above by a light gray thin area. After an interruption at the level of the tympanum, the black stripe continues till above the shoulder. On the snout, at about mid-length between the eyes and the tip of the snout, a transversal bars links the left and right canthal stripes. The supralabials and infralabials are whitish. Similarly to the dorsal surface of the head, the neck, the dorsum and the dorsal surface of the original portion of the tail show a gray background color with numerous, irregularly disposed, black spots (Figure 1). Flanks lighter than the dorsum and less punctuated. Dorsal surfaces of members gray with small black spots. Ventral surfaces of head, body, members and tail whitish. In preservative the colors strongly fade and become less contrasted (Figures 2 and 3).

Variation. The main morphometric and meristic characters of the type series are provided in Table 1. Morphological characters of the paratypes agree in most respects with the holotype. The last 22.1 mm of the tail of the male paratype are regenerated. The female paratype has an original tail and shows a TailL/SVL ratio of 1.17. Similarly to the holotype, the male paratype has a continuous series of pores. Precloacal pores are absent in the female. Depending on the individuals, the background color of the body is gray to brown, and the pattern varies from spotted to uniform (Figures 1, 4 and 5). The dorsal pattern does not seem to show a clear sexual dimorphism, although all fully spotted individuals observed were males, and totally uniform patterns were found only in females.

Distribution and natural history. All individuals of the new species were found active at night on large sandstone platforms and boulders at the type-locality. We also observed numerous individuals in Pha Taem National Park at Soi Sawan Waterfall (15°27’38.4”N, 105°34’40.5”E) and surrounding sandstone outcrops (Figures 6 and 7). In each of these locations the vegetation is sparse, and includes patches of grass, bamboos and shrubs. *Dixonius mekongensis* **sp. nov.** is locally abundant. We found a single other squamate species in strict syntopy in all sites, *Gekko petricolus* Taylor, another sandstone obligate gecko.

Etymology. The specific epithet refers to the Mekong River and the Greater Mekong Subregion. A cliff bordering the type-locality offers a spectacular view of this majestic river. We suggest the following common names:

จิงจกดินแม่โขง (*Djing-djok din Mekong*, Thai), Mekong leaf-toed gecko (English), *Dixonius du Mékong* (French), and *Mekong Blattfingergecko* (German).

Comparison to other species. The main diagnostic morphological and chromatical characters of *Dixonius* species are presented in Table 2. *Dixonius mekongensis* **sp. nov.** is distinguished from the Vietnamese *D. aaronbaueri* Ngo & Ziegler, 2009 based on its sensibly larger SVL (51.2 vs. 38.6 mm), higher Ven number (22–24 vs. 18 or 19), much higher DTR number (16 vs. 11), much lower PV number (32–34 vs. 45–50), much lower PV' number (20–24 vs. 29–32), and its higher PrePo number (7 vs. 5). It differs from the southern Thai *Dixonius dulayaphitakorum* Sumontha & Pauwels, 2020 by its much lower DTR number (16 vs. 22), its lower ICS number (25–27 vs. 30–33), its marked (vs. unmarked) canthal stripe, and a very distinct dorsal pattern with smaller dorsal spots. It can be separated from the western Thai *Dixonius hangseesom* Bauer, Sumontha, Grossmann, Pauwels & Vogel, 2004 by its larger SVL (51.2 vs. 42.1 mm), higher DTR number (16 vs. 12–14), lower InterOrbS number (8 or 9 vs. 10) and a distinct dorsal pattern (U/Sp vs. Ba/Bl). It differs from the peninsular Thai *Dixonius kaweesaki* Sumontha, Chomngam, Phanamphon, Pawangkhanant, Viriyapanon, Thanaprayotsak & Pauwels, 2017 by its larger SVL (51.2 vs. 41.6 mm), shorter original tail in females (TailL/SVL ratio 1.17 vs. 1.36–1.55), higher DTR number (16 vs. 12 or 13), higher InterOrbS number (8 or 9 vs. 6 or 7), lower SL number (7–9 vs. 10 or 11), lower PrePo number (7 vs. 9–11) and by its dorsal pattern (Sp or U vs. St). It differs from the Laotian *Dixonius lao* Nguyen, Sitthivong, Ngo, Luu, Nguyen, Le & Ziegler, 2020 by its much lower DTR number (16 vs. 20–23), much lower PV number (32–34 vs. 40–43), lower PrePo number (7 vs. 8), and by its marked (vs. unmarked) canthal stripe. It can be separated from *Dixonius melanostictus* Taylor, 1962 by its much higher DTR number (16 vs. 10 or 11), lower PrePo number (7 vs. 9), and by its dorsal pattern (U/Sp vs. St). It is distinguished from the Vietnamese *Dixonius minhlei* Ziegler, Botov, Nguyen, Bauer, Brennan, Ngo & Nguyen, 2016 by its higher DTR number (16 vs. 14 or 15), lower PV number (32–34 vs. 38–44), and smaller black dorsal spots. It differs from the peninsular Thai *Dixonius pawangkhananti* Pauwels, Chomngam, Larsen & Sumontha, 2020 by its larger SVL (51.2 vs. 42.6 mm), shorter original tail in females (TailL/SVL ratio 1.17 vs. 1.33), much higher Ven number (22–24 vs. 16), higher InterOrbS number (8 or 9 vs. 7), higher PrePo number (7 vs. 6), its continuous series of pores in males (vs. a series medially interrupted by a poreless scale), and by its dorsal pattern (U/Sp vs. Ba/Bl). It differs from *Dixonius siamensis* by its smaller SVL (51.2 vs. 57.0 mm), its higher DTR number (16 vs. 10–14) and its marked (vs. unmarked) canthal stripe. *Dixonius mekongensis* **sp. nov.** can be distinguished from the Laotian *D. somchanhae* Nguyen, Luu, Sitthivong, Ngo, Nguyen, Le & Ziegler by its lower DTR number (16 vs. 19–21), lower PV number (32–34 vs. 35–40), and higher PrePo number (7 vs. 5 or 6). It can be separated from the Vietnamese *Dixonius taoi* Botov, Phung, Nguyen, Bauer, Brennan & Ziegler, 2015 by its larger SVL (51.2 vs. 43.9 mm), much higher DTR number (16 vs. 11 or 12), higher PrePo number (7 vs. 5 or 6), and by its dorsal pattern (U/Sp vs. Bl). From *Dixonius vietnamensis* Das, 2004, it differs by its larger SVL (51.2 vs. 42.4 mm), higher Ven number (22–24 vs. 15–21), and its lower PV number (32–34 vs. 36). The type-localities of all currently recognized *Dixonius* species recorded in Thailand are mapped on Figure 8.

Discussion

Part of the known distribution of *Dixonius mekongensis* **sp. nov.** lies within a national park and hence the new species, locally abundant, benefits from a high level of protection. In spite of much field research over the last two decades we have never found it in other sites of the eastern Isan Region. It is probably highly infeodated to the sandstone substrate, similarly to the strong link between several other micro-endemic *Dixonius*, such as *D. kaweesaki*, with limestone (Nguyen *et al*. 2020; Pauwels *et al*. 2020). We have never seen this species in the local or international pet trade, and no direct threats on its population were observed. Thus in spite of its presumably very limited geographic distribution, *Dixonius mekongensis* **sp. nov.** does not currently seem to be at risk.

Singtuen & Won-In (2019) stressed the exceptional value of the sedimentary outcrops of Pha Taem National Park in terms of geomorphological heritage and prehistoric rock art, and regretted that they do not get more international publicity. The description of an endemic vertebrate is a noteworthy addition to the unique heritage represented by this protected area, and hopefully will further help promote its conservation.

Dixonius mekongensis **sp. nov.** is the 13th species recognized in the genus. It is the sixth believed to be endemic to Thailand, along with *Dixonius hangseesom* from western Thailand, *D. dulayaphitakorum*, *D. kaweesaki* and *D. pawangkhananti* from peninsular Thailand, and *D. melanostictus* from central Thailand.

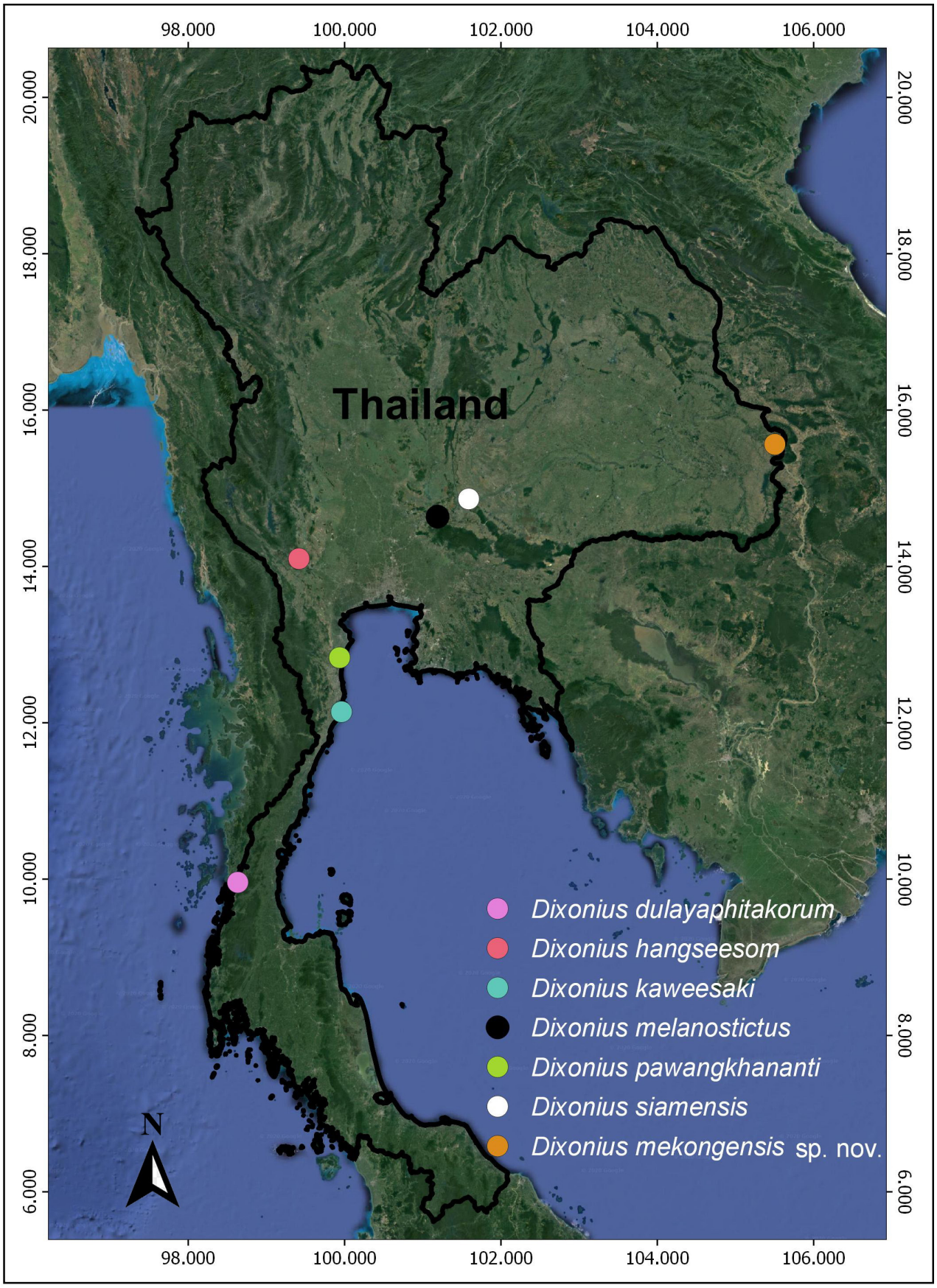

FIGURE 8. Map showing the positions of the type-localities of all *Dixonius* species currently recorded from Thailand. Map by W. Sodoab.

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APPENDIX. Comparative material examined.

Dixonius dulayaphitakorum: see AUP and PSUZC type material listed in Sumontha & Pauwels (2020).
Dixonius hangseesom: see CUMZ-R and RBINS type material listed in Bauer *et al*. (2004).
Dixonius kaweesaki: see PSUZC, THNHM and ZMKU type material listed in Sumontha *et al*. (2017).
Dixonius pawangkhananti: see AUP, PSUZC and THNHM type material listed in Pauwels *et al*. (2020).
Dixonius siamensis: Cambodia: RBINS 18571-18572, Ou Krieng, Kratie Prov.; RBINS 18573, Chrouy Banteay, Kratie Prov. Thailand: CUMZ-R 2003.59, near Sai Yok Waterfall, Sai Yok District, Kanchanaburi Prov.; RBINS 15155, Ban Khao Kling, Kaeng Krachan District, Phetchaburi Prov.; RBINS 16642, Chiang Mai City, Muang District, Chiang Mai Prov.; RBINS 16643, Doi Saket, Doi Saket District, Chiang Mai Prov.; RBINS 16645, foot of Khao Loun, Ban Nong Ipho, Ban Lat District, Phetchaburi Prov.; RBINS 17015 (4 specimens), Hin Chang See, Ban Fang District, Khon Kaen Prov.; MNHN-RA 1998.0522, Ban Tham Rong, Ban Lat District, Phetchaburi Prov.; MNHN-RA 1998.0529, Doi Saket, Doi Saket District, Chiang Mai Prov.; MNHN-RA 1999.7606, Ban Salakern, Ban Lat District, Phetchaburi Prov.; MNHN-RA 1999.7627, Huay Kwang Jing, Tha Yang District, Phetchaburi Prov.; THNHM 1282, island in Kaeng Krachan Reservoir, Kaeng Krachan District, Phetchaburi Prov.; THNHM 1299–1305, Forestry Training Center, Cha-am, Cha-am District, Phetchaburi Prov.