

A New Species of *Lepidophyma* (Squamata: Xantusiidae) from the Pacific Lowlands of Guerrero, Mexico

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ABSTRACT.—We describe a new species of the genus *Lepidophyma* from the Pacific lowlands of Guerrero, southern Mexico. Previously referred to as *L. smithii*, the new taxon is distinguished by a series of morphological characteristics, principally higher numbers of gulars, paravertebrals, and lateral tubercle rows. This new species increases the number of described *Lepidophyma* to 20 species.

RESUMEN.—Se describe una nueva especie del género *Lepidophyma* de las tierras bajas del Pacífico de Guerrero, sur de México. Esta nueva especie fue referida en el pasado a *L. smithii* pero puede ser diferenciada de esta por una serie de características morfológicas, principalmente por tener un mayor número de escamas gulares, paravertebrales e hileras de tubérculos laterales. Esta especie eleva el número de *Lepidophyma* descritas a 20.

Night lizards of the family Xantusiidae comprise three genera restricted to the New World, ranging from the southwestern United States and northwestern Mexico (*Xantusia*), Middle America (*Lepidophyma*), and a single species (*Cricosaura typica*) inhabiting southern Cuba. The systematics of the genus *Lepidophyma* have received some attention in the last decades. Bezy and Camarillo (2002) undertook a systematic revision of the genus and recognized a total of six species groups. Two new species were recently described from southern Mexico (Canseco-Márquez et al., 2008; García-Vázquez et al., 2010), and a recent phylogenetic analysis demonstrated the monophyly of the extant genera within the family (Noonan et al., 2013).

The genus *Lepidophyma* is particularly species rich in Mexico. Of the 19 species formally recognized to date, 15 are endemic to the country and in some cases their distributions are restricted to particular mountain ranges. Two species, *L. smithii* and *L. flavimaculatum*, have been reported to be broadly distributed in Mexico and Central America, but the former is recovered as paraphyletic with respect to *L. lineri* and the latter includes a previously unrecognized species from Chiapas, Mexico (Noonan et al., 2013). The most recent phylogenetic analysis of the genus recognized three moderately supported major clades: 1) a southern clade comprising six species, 2) a northern clade with three species, and 3) a Tehuantepec clade composed of a) four small-bodied rock-crevice species and b) two large-bodied generalist species. Two additional species were not allocated to any of these groups defined by molecular sequence data (Noonan et al., 2013).

During the review of museum specimens and our fieldwork, a series of a large night lizard species was obtained from the vicinity of Tierra Colorada, municipality of Juan R. Escudero, Guerrero, a well-known endemism hot spot. Comparisons made with specimens representing most other species in the genus led us to recognize this population as a new species that we describe here.

MATERIALS AND METHODS

Specimens we collected were fixed in 10% buffered formalin, preserved in 70% ethanol, and deposited in the herpetological collection of the Museo de Zoología “Alfonso L. Herrera,” Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC). We compared individuals of the new species with type series of *L. cuicateca*, and *L. zongolica*, and the holotypes of *L. radula*, *L. lowei*, *L. lipetzi*, and *L. dontomasi*. These comparisons were augmented with previously published data from Bezy and Camarillo (2002) and Flores-Villela et al. (2005). Museum acronyms follow Sabaj-Pérez (2016).

Scale terminology and characters in the diagnosis and descriptions follow those proposed by Savage (1963), Bezy and Camarillo (1999, 2002), and Gauthier et al. (2008). Scale counts were taken with the aid of a dissecting microscope. We recorded measurements with a digital caliper to the nearest 0.1 mm and scored data for the following characters: snout–vent length, tail length, gulars, number of gulars contacting first infralabial, and numbers of: dorsals, dorsals along paravertebrals, paravertebrals, dorsal interwhorls, ventral interwhorls, femoral pores, fourth toe lamellae, lateral tubercle rows, and the presence/absence of a parietal spot (Appendix 1).

RESULTS

Lepidophyma inagoi, sp. nov.

Figures 1, 2; Table 1

Lepidophyma smithii Mendoza-Hernández and Santos-Barrera, 2004; Canseco-Márquez et al., 2008; García-Vázquez et al., 2010.

Holotype.—MZFC 30706 (field number: RPA-179); adult female obtained from Carretera Omitlán-La Venta, municipality of Juan R. Escudero (17.1345°N, 99.5445°W; Datum = WGS-84), elevation 145 m, Guerrero, Mexico by Ricardo Palacios-Aguilar (Figs. 1, 2) on 15 September 2016. The vegetation at this locality is dominated by tropical deciduous forest.

Paratypes.—Five specimens, all from the same region as the holotype. MZFC 16183–16184 from Cerro El Tepehuaje, ~10 km SE Tierra Colorada (17.11856°N, 99.521856°W), elevation 234 m; MZFC 30707, a juvenile specimen from Cerro de Tierra Colorada,

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FIG. 1. Adult female specimen of *Lepidophyma inagoi* in life (MZFC 30706, holotype).

Potrero Oriental (17.163764°N, 99.5038723°W), elevation 670 m; MZFC 30712, adult male from Garrapatas, municipality of Juan R. Escudero (17.19467°N, 99.52°W), elevation 523 m; MZFC 31979, an adult female from Palo Gordo, municipality of Juan R. Escudero, Guerrero, Mexico (17.1536°N, 99.5461°W), elevation 245 m.

Diagnosis.—The new species differs from *L. dontomasi*, *L. gaigeae*, *L. lowei*, *L. radula*, *L. tarascae*, *L. mayae*, *L. pajapanense*, *L. lipetzi*, *L. cuicateca*, and *L. zongolica* in having ≥ 190 dorsal scales (190–215 vs. 120–190); from *L. chicoasense*, *L. reticulatum*, and *L. tuxtlae* in having more gulars (58–63 vs. 37–56) and fewer lateral tubercle rows (25–27 vs. 28–47); from *L. smithii* in having more paravertebrals (71–91 vs. 35–69); from *L. micropholis* and *L. occulor* in having fewer dorsals (190–215 vs. 213–265); from *L. flavimaculatum* in that the size of enlarged tubercles on the dorsal and lateral surfaces is smaller (bigger), by the absence of a parietal spot in adults and juveniles, and by having one broad temporal scale between postoculars and the suture between the sixth and seventh supralabials (vs. ≥ 2 small scales in *L. flavimaculatum*; Fig. 2).

Furthermore, *L. inagoi* is readily distinguished from *L. dontomasi*, *L. lowei*, and *L. radula* in having more ventral interwhorls (2 vs. 1); from *L. cuicateca*, *L. dontomasi*, *L. lineri*, *L. lipetzi*, *L. lowei*, *L. mayae*, *L. pajapanense*, *L. radula*, *L. tarascae*, *L. tuxtlae*, and *L. zongolica* in having more paravertebrals (71–91 vs. 37–68); from *L. chicoasense*, *L. cuicateca*, *L. lipetzi*, *L. lowei*, *L. mayae*, *L. pajapanense*, *L. reticulatum*, and *L. tuxtlae* in having fewer lateral tubercle rows (25–27 vs. 28–73); and from *L. chicoasense*, *L. gaigeae*, *L. lipetzi*, *L. mayae*, *L. micropholis*, *L.*

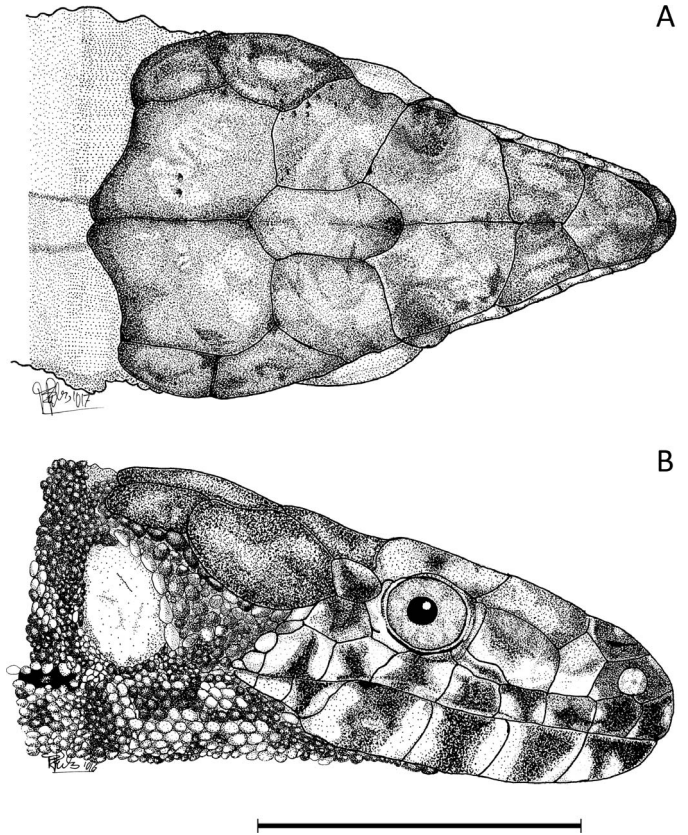


FIG. 2. Dorsal (A) and lateral (B) view of the holotype of *Lepidophyma inagoi* (MZFC 30706). Scale bar = 1 cm.

pajapanense, *L. reticulatum*, and *L. zongolica* in having fewer femoral pores (total, both legs, 20–24 vs. 28–43).

Description of Holotype.—An adult female, 82 mm in snout–vent length; tail 112.3 mm; head length 18.7 mm; head width 11.9 mm; head depth 8.7 mm; orbit diameter 2.9 mm; fourth toe length 13.1 mm.

Rostral scale wider than long, bordered by two supranasals and two supralabials. Supranasals bordered posteriorly by a single frontonasal, two prefrontals; no frontal; interparietal lacking parietal spot, bordered by frontoparietals, parietals, and two occipitals; two supratemporals on each side, contacting parietals and occipitals (Fig. 2A). Nostril bordered by supranasal, postnasal, and the first supralabial, followed by two loreals; anterior loreal higher than postnasal, posterior loreal wider than anterior loreal. Supralabials 8/8 (eighth smallest), fifth entering orbit (Fig. 2B). Supraoculars bordered by two supratemporals and frontoparietals (median supratemporal enlarged); postoculars in contact with fifth and sixth supralabials. Six enlarged, pale auricular scales bordering anterior edge of tympanum.

TABLE 1. Variation in selected morphological features of the type series of *Lepidophyma inagoi*. Abbreviations are as follow: SVL = snout–vent length, TL = tail length, GUL = gulars, DOR = dorsals, DAPVR = dorsals along paravetrebral row, PVR = paravertebrals, FPT = total femoral pores, FTL = fourth toe lamellae, LTR = lateral tubercle rows, H = holotype, P = paratype.

Specimen	SVL (mm)	TL (mm)	GUL	DOR	DAPVR	PVR	FPT	FTL	LTR
MZFC 16183 P	89.4	95.7	59	200	104	84	20	26	27
MZFC 16184 P	89.4	121	59	199	108	78	21	22	25
MZFC 30707 P	55.8	75.1	58	190	105	71	24	20	25
MZFC 30712 P	91.5	115.1	63	207	118	78	23	20	25
MZFC 31979 P	106.6	96.5	60	205	117	91	22	24	25
MZFC 30706 H	81.9	112.34	59	215	95	85	21	24	25



FIG. 3. Tropical deciduous forest at the type locality in Omitlán, municipality of Juan R. Escudero, Guerrero, Mexico.

Dorsal and lateral body surfaces covered by numerous scales of varying shapes and sizes; dorsal surface with numerous slightly enlarged, weakly keeled tubercles ($\sim 3\times$ adjacent mid-dorsal scales); 28 enlarged tubercles along paravertebrals between axilla and groin.

Vertebral area with enlarged tubercles; 3 or 4 smaller scales between tubercles; 215 vertebrae. Large tubercles on sides of body arranged in vertical rows separated by smaller scales; 25 lateral tubercles in axilla–groin region; lateral tubercle rows nearly contact paravertebrals.

Ventral scales smooth, flat, almost quadrangular in shape; arranged in 10 rows along mid-body; 38 transverse rows including 3 rows of preanals (4 anterior preanals, 2 median, and 4 posterior); median row of preanals wider than high, and larger than the others. Scales on ventral surfaces of limbs slightly keeled and heterogeneous in size; 21 femoral pores (10/11); fourth toe lamellae 24 excluding terminal, bearing claw.

Tail encircled by whorls of enlarged quadrangular scales, slightly keeled; each separated by three rows of smaller scales dorsally and two ventrally.

Coloration of Holotype in Preservative.—Dark brown in all dorsal surfaces; small white spots arranged along the paravertebral rows, fading on the posterior two-thirds of the body; lateral tubercle rows light gray or white; three dorsolateral rows of white spots on the neck fading toward the gular region. Head light brown with darker coloration in the distal portion of the parietals, temporals, and nasals; supralabials and infralabials with dark brown bars in the center and white in the sutures of the scales. Gular region white with dark speckling; venter dirty white with dark brown bordering on the scales, last eight transversal rows of scales above the hip almost completely brown except for a pale center; ventral surfaces of the limbs light brown; ventral surfaces of the tail dark brown.

Variation.—Aside from ontogenetic size variation, very little mensural or meristic variation is evident in our small type series. Variation among selected features of the type series is presented in Table 1.

Color Variation in Life (Color in Preservative Presented in Parentheses).—Head light brown dorsally with a darker hue in the distal portion of the parietals, and lateral sides; light yellow markings on the sutures of supralabials and infralabials (white in preservative). Dorsum dark brown with scattered yellow spots

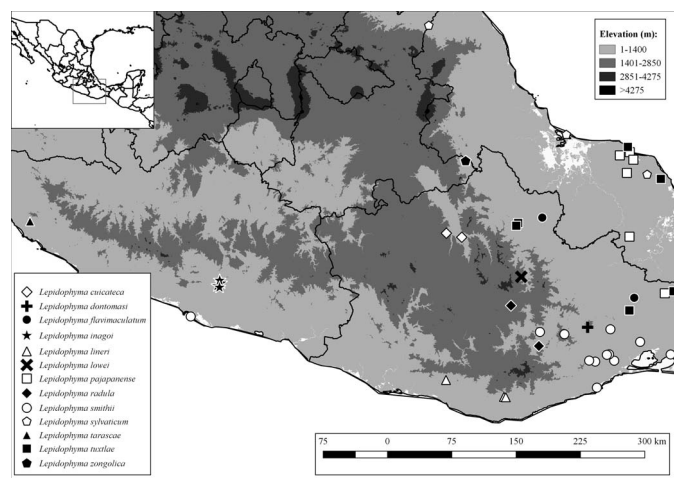


FIG. 4. Map showing the distribution of the genus *Lepidophyma* in southern Mexico.

along the paravertebral rows (white) more densely aggregated in the anterior portion of body. Ventral surface pale yellow or white with brown edges on the scales of the venter, although some specimens may have an almost completely brown belly (MZFC 16184) or a dark brown coloration on the lower transversal scale rows just above the hip (MZFC 30706), light brown on the ventral surfaces of limbs; juvenile specimens with pale orange coloration on the belly (light pink), ventral view of the tail dark brown. Gular region with a pale yellow (white) background with some dark speckling in some specimens (MZFC 16183-84, 30706), and many light spots over a dark background color on the lateral sides of the neck.

Etymology.—The name *inagoi* is a patronym honoring our friend and colleague, Iván Nava González, who passed away in late December 2014.

Distribution and Habitat.—The new species apparently is restricted to the tropical deciduous forest around the Tierra Colorada region (Figs. 3, 4). It is relatively abundant locally and like some other representatives of the genus, it appears to be saxicolous, and restricted to cave systems, rock walls, and holes at the base of rocks. During the day, individuals can be found inside caves formed by large granitic boulders or rock crevices. During the afternoon and at night the species apparently shifts to a preferred microhabitat at cave entrances.

Other species of amphibians and reptiles recorded in the vicinity of the type locality were: *Incilius marmoreus*, *Anolis dunni*, *A. gadovii*, *A. subocularis*, *Aspidoscelis sacki*, *As. gutatta*, *Boa sigma*, *Leptodeira nigrofasciata*, *Marisora brachypoda*, *Sceloporus horridus*, *S. stejnegeri*, *Phyllodactylus delcampoi*, *P. tuberculatus*, *Indotyphlops braminus*, and *Urosaurus bicarinatus*.

Natural History.—On the basis of the presence of elytra in a fecal sample of the holotype, we infer an insectivorous diet in *Lepidophyma inagoi*. Mautz and López-Forment (1978) have reported an omnivorous and opportunistic diet in *L. smithii*, and we acknowledge that *L. inagoi* could also be omnivorous. Mautz (1963) also reported that *L. smithii* shares habitat with *Phyllodactylus lanei* near Puerto Marqués, suggesting resource partitioning in microhabitat use and diet. A similar interaction with shared microhabitat and activity patterns has been observed in sympatric *L. inagoi* and the larger *P. delcampoi*; however, further observations are necessary to elucidate more subtle ecological relationships among these two taxa.

Remarks.—This description of *L. inagoi* brings the number of described species in the genus to 20. The species is known only from the Tierra Colorada region in the western edge of the municipality of Juan R. Escudero in Guerrero, Mexico. This particular region harbors an interesting set of micro-endemic lizards such as *P. delcampoi*, *A. gadovii*, and *S. stejnegeri*.

From our personal observations from the type locality and surrounding area, we speculate that these endemic lizards may be tightly associated with the unique local microhabitat represented by the presence of tropical deciduous forest growing over large granitic boulders and forming cave systems, crevices, and cliffs (Fig. 3).

The most geographically proximate congener of *L. inagoi* is the morphologically similar *L. smithii*, located ~40 km south from the type locality in Puerto Marqués, Acapulco (Sánchez and López-Forment, 1987). This similarity presumably has contributed to the failure of past researchers to recognize the new species (Mendoza-Hernández and Santos-Barrera, 2004; Canseco-Márquez et al., 2008; García-Vázquez et al., 2010); however, *L. inagoi* differs from Puerto Marqués *L. smithii* in having more gulars, paravertebrals, and lateral tubercle rows. The only other congeneric taxa known from Guerrero is *L. tarascae* (Palacios-Aguilar and Flores-Villela, 2018), from which the new species can be differentiated by having more gulars (58–63 vs. 40–49), dorsals (190–215 vs. 145–162), and reduced size of dorsal body tubercles.

DISCUSSION

On the basis of the former taxonomic arrangements inferred from morphological (Bezy, 1984; Bezy and Camarillo, 1992, 2002) and phylogenetic analyses of molecular sequence data (Sinclair et al., 2010; Noonan et al., 2013), distinct species groups of *Lepidophyma* have been identified: a northern clade (the northeastern species group of Bezy [1984] excluding *L. gaigeae*), a southern clade (the *flavimaculatum* and *tuxtlae* [excluding *L. pajapanense*] groups of Bezy and Camarillo [2002]), and a Tehuantepec clade composed of small-bodied rock-crevice species (*L. cuicateca*, *L. dontomasi*, *L. lowei*, and *L. radula*; “clade a”) and large-bodied generalist species (the *smithii* group [excluding *L. tarascae*] of Bezy and Camarillo, 2002; “clade b”).

The relationships of *L. pajapanense* remain unresolved by the sequence data because of the ambiguous placement of this species on a polytomy at the base of the clade; *L. gaigeae* exhibits a poorly supported relationship with the recovered groups of Noonan et al. (2013), and to date, sequence data from *L. chicoasense*, *L. tarascae*, *L. zongolica*, and *L. inagoi* are unavailable. Nevertheless, the distribution and morphological characters of *L. inagoi* allow us to tentatively assign the new species to the latter group (Tehuantepec clade b). The new species was collected in similar habitat (large boulders, on the Pacific slope of the Sierra Madre del Sur), and occurs approximately at the same elevation as other members of this group (*L. smithii* and *L. tarascae*), to whom we assume it is closely related. Because of the cryptic diversity, however (noted in the *L. smithii* clade by previous authors; Noonan et al., 2013), inclusion of the new species in a phylogenetic analysis would be desirable to establish its taxonomic affinities.

This new taxon adds to the rich endemic herpetofauna of the Sierra Madre del Sur (Flores-Villela et al., 2010), a mountain chain still harboring virtually pristine forests that have been preserved, until recently, by their inaccessibility and security

concerns. We suspect that other undescribed taxa may soon be discovered as researchers begin to access more remote sites in this region.

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APPENDIX 1. SPECIMENS EXAMINED

Lepidophyma chicoasense. MEXICO: Chiapas: Cañón del Sumidero (MZFC 11496).

Lepidophyma cuicateca. MEXICO: Oaxaca: 1 km SE Santa María Texcatitlán (MZFC 16419, holotype; 16420–16421, MZFC 19736, MZFC 19738, paratypes); 1.5 km E Santiago Dominguillo (MZFC 19749, paratype).

Lepidophyma dontomasi. MEXICO: Oaxaca: Lachiguiri, at 7,100 feet (USNM 111473, holotype; UCM 39887, 41147).

Lepidophyma flavimaculatum. MEXICO: Chiapas: Coapilla, 17°06'12"N, 93°08'10"W, 1,520 m (MZFC 24572); Ocosingo, Loma Bonita (CNAR 25332); Zona Arqueológica "Yaxchilán" (MZFC 11973; MZFC 12184; MZFC 13191); Oaxaca: Jacatepec, cerca de Tuxtepec (CNAR 18671); Tabasco: Macuspana, Agua Blanca, 17°37'10"N, 92°28'14"W (CNAR 24470); Veracruz: Coatzacoalcos, Tuzandepetl, 18°01'26"N, 94°26'10"W (CNAR 26288). MZFC 28844; MZFC 25936.

Lepidophyma gaigeae. MEXICO: Hidalgo: Barranca de Los Mármoles a lo largo de la carretera 85, W Jacala (MZFC 11201); Zimapán, El Salto (carretera Mex. 85 Zimapán-Jacala, km 160), 20°54'04.9"N, 99°12'51.5"W (MZFC 24345); Zimapán, Verdosas, 20°49'36"N, 99°24'36"W (MZFC 7782); Querétaro: 3 km al Sur de El Madroño (MZFC 5548); Acatitlán de Zaragoza (MZFC 5363); Cadereyta de Montes, Cerro Prieto, N de Rancho Nuevo (MZFC 7783).

Lepidophyma lineri. MÉXICO: Oaxaca: San Gabriel Mixtepec, 2 km de San Gabriel Mixtepec, 16°06'45.6"N, 97°03'58"W, 724 m (MZFC 22144); San Miguel Chimalapa, Cerro Atravesado NE El Palmar (MZFC 16998); Pluma Hidalgo, Camino a Finca El Jordán, 15°55'45.9"N, 96°26'15.5"W (MZFC 22622, MZFC 22627); Pluma Hidalgo, Desviación a Vista Hermosa, 516 m (MZFC 22596); Pluma Hidalgo, Río Juquilita (MZFC 22628).

Lepidophyma lipetzi. MEXICO: Chiapas: Carretera Ocozocuatla-Apic-Pac, km 23 (MZFC 6958); Lago del Mal Paso, headwaters of Rio de La Venta (UCM 51425, holotype).

Lepidophyma lowei. MEXICO: Oaxaca: 4.0 km (by road) SE San Bartolomé Zoogocho, Municipio Zoogocho, former Distrito Villa Alta, Oaxaca, México, 17°14'N, 96°15'W, 2,000 m (CNAR 7500, holotype, CNAR 7497–7499, paratypes).

Lepidophyma micropholis. MEXICO: San Luis Potosí: Ciudad Valles, Cueva de El Tigre, detrás del hotel Taninul (MZFC 25693).

Lepidophyma occulor. MEXICO: San Luis Potosí: Xilitla (5561–5562 [two specimens]); approximately km 4.0 carretera Xilitla-Tamazunchale, W (MZFC 7591).

Lepidophyma pajapanense. MEXICO: Oaxaca: 3 km W Chalchijpa (MZFC 18681); 4 km W Chalchijpa (MZFC 18692). Veracruz: Santa Marta, Bastonal (MZFC 4302).

Lepidophyma radula. MÉXICO: Oaxaca: 3.5 km from San Pablo Villa de Mitla, on the road to San Pablo Ayutla (MZFC 15524–15526; UTA 52402); San José Manteca, 5 km from San Carlos Yautepec (USNM 111472, holotype).

Lepidophyma smithii. MÉXICO: Chiapas: Pijijiapan, Rancho de Tito Cabrera, km 170 Carretera Arriaga-Tapachula, Col. Miguel Alemán (Jericó), Rancho 3 Hermanos (MZFC 19007, MZFC 19009–19010); Guerrero: Acapulco, Puerto Marqués (MZFC 26465); Oaxaca: Carretera Huatulco-Salina Cruz, deviation to Santa Cruz Bamba, 200 m (MZFC 21624); Cerro Piedra Larga (MZFC 8732); Santa Cruz Bamba, 16°01'49"N, 95°25'11.2"W (MZFC 21658).

Lepidophyma sylvaticum. MEXICO: Hidalgo: 5 km E Tlanchinol, arroyo Apantlazol, 1550 m (MZFC 21016); Molango (MZFC 6379). Tamaulipas: 7 km E Joya de Salas (MZFC 11084); El Panehan cave; 4.8 mi N Antigua Morelos (MZFC 19486); en camino La Gloria-Las Palmas, SW de Estación Canindo (MZFC 8516).

Lepidophyma tarascae. MÉXICO: Colima: 1 km NW San Gabriel (MZFC 19776). Guerrero: Ejido San Ignacio, 200 m N El Abrojal (MZFC 18078). Michoacán: La Virgen, Barranca La Alberca, camino de terracería de Aguililla-Dos Aguas (MZFC 8603).

Lepidophyma tuxtlae. MEXICO: Oaxaca: San Isidro La Gringa (MZFC 18682); Santa María Chimalapa, 1–3 km Cabaña SEDESOL, camino a Nueva Guadalupe y Las Mercedes, 17°04'59.4"N, 94°03'24.8"W (MZFC 18678–18679), 2 km SW Campamento Piloto Chalchijapa, 17°04'37"N, 94°35'57"W (MZFC 18684, MZFC 19045); Veracruz: Montepío, 2 km antes de Tuxtla (MZFC 4668); San Andrés Tuxtla, SW ladera del Volcan San Martín, Rancho Primero del Maio (sic), approximately 12.3 km ENE Tapalapan (MZFC 10629).

Lepidophyma zongolica. MEXICO: Puebla: El Tepeyac, Municipio de Eloxochitlán (MZFC 22186, holotype; MZFC 22183–85, paratypes); Carretera Rancho Nuevo-El Tepeyac (MZFC 22180–22182, paratypes).