

A New Species of *Gerrhonotus* (Squamata: Anguidae) from the Cuatro Ciénegas Basin, Coahuila, Mexico

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ABSTRACT: A new species of *Gerrhonotus*, previously confused with *G. infernalis*, is described from the Cuatro Ciénegas Basin, Coahuila, Mexico. The new species is known from the type locality only and is characterized by the following combination of characters: a cantholoreale scale usually present, a dark mark extending anteriorly from the lower temporal scales through the lower border of the orbit to the preocular or cantholoreale scales, keeled dorsal scales, dorsal body pattern usually composed of cross-bands mostly interrupted or barely discernible on middorsum, usually indiscernible vertical dark bars on the lateral fold (few, faint bars occasionally present), and black flecks scattered on the venter. The new species is geographically closest to *G. lugoi* and *G. infernalis* but morphologically most similar to *G. infernalis*.

Key words: Alligator lizards; Cryptic species; Gerrhonotinae; Taxonomy

THE ANGUID lizard genus *Gerrhonotus* Wiegmann 1828 is a conspicuous component of the herpetofauna of south-central United States and Mexico. The genus is characterized by the loss of at least one scale in the canthal/loreal series and the possession of five or fewer temporals per vertical row, 10–14 longitudinal rows of ventrals, four large and one small pairs of chinshields, and a light-on-dark dorsal cross-banding pattern (Good 1988; García-Vázquez et al. 2018). Currently, eight species of *Gerrhonotus* are formally recognized. Good (1994), in a comprehensive study of species limits in the genus, recognized four species: *Gerrhonotus lugoi* McCoy 1970 distributed in the Sierra de San Marcos y Pinos and Sierra de la Madera mountain ranges surrounding the Cuatro Ciénegas Basin (CCB) in central Coahuila, Mexico, and an isolated population in central Nuevo León (García-Vázquez et al. 2016); *G. infernalis* Baird 1859 distributed from central and west-central Texas, USA, south to central Hidalgo, Mexico, with isolated populations in south-central Chihuahua and adjacent Durango and southwestern Coahuila and adjacent Durango (Good 1994; Ramírez-Bautista et al. 2010); *G. liocephalus* Wiegmann 1828 distributed from central Guerrero and central Puebla south and east to southeastern Chiapas, with an isolated population in the Los Tuxtlas mountain range in southern Veracruz; and *G. ophiurus* Cope 1867 distributed from southeastern San Luis Potosí and southeastern Tamaulipas (García-Padilla and Villegas-Ruiz 2010) southeast to central Veracruz, Mexico. In addition, *G. parvus* Knight and Scudday 1985 was described from the Sierra Madre Oriental in west-central Nuevo León. This species was subsequently transferred to the genus *Elgaria* Gray 1838 by Smith (1986) and then placed back into *Gerrhonotus* by Conroy et al. (2005). Bryson and Graham (2010) described *G. farri* Bryson and Graham 2010, and Banda-Leal et al. (2017) described *G. lazcanoii* Banda-Leal, Nevárez-de los Reyes and Bryson 2017, both from the

Sierra Madre Oriental of extreme southwestern Tamaulipas and central Nuevo León, respectively. Finally, *G. rhombifer* Peters 1876 was described from the Province of Chiriquí in western Panamá. Later, Tihen (1949) erected the monotypic genus *Coloptychon* Tihen 1949 to accommodate this species. García-Vázquez et al. (2018) placed *C. rhombifer* back into *Gerrhonotus*, however, raising the number of recognized species in this genus to eight.

Good (1994) tentatively referred certain populations of *Gerrhonotus* in western Mexico (from Durango, Sinaloa, Jalisco, and Colima) to *G. liocephalus* (his *G. cf. liocephalus* Samples 19 and 20). However, presumably because the limited number of available samples hindered a proper characterization of the geographic variation of morphological characters within and among *Gerrhonotus* species, Good (1994) was unable to determine with certainty whether these populations were conspecific with *G. liocephalus* or represented one or more distinct species. Recently, Castiglia et al. (2010) provided molecular evidence suggesting that populations of *Gerrhonotus* from western Jalisco might represent an undescribed species. While preparing this paper, based on the revision of a greater sample of specimens, we have gathered morphological and molecular evidence that corroborates this suggestion (A. Nieto-Montes de Oca, personal observation) and describe this species elsewhere. For the purposes of this paper, we refer to this undescribed taxon as *Gerrhonotus cf. liocephalus* from Western Mexico.

In a scientific meeting in 1989, A. Contreras-Arquieta (personal communication) suggested that the population of *Gerrhonotus* in the vicinity of the CCB, Coahuila, represented a new subspecies of *G. liocephalus* (*G. liocephalus aguayoi*) and provided a brief description for this taxon in the abstract for the meeting. Good (1994), however, was unable to include this taxon in his analysis of species limits in the genus and assigned all populations of *Gerrhonotus* from Coahuila to *G. infernalis*. Nonetheless, examination of several specimens of *Gerrhonotus* from the CCB and the

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surrounding mountains, as well as additional specimens of *Gerrhonotus* from Mexico and the United States, suggested that the population from the CCB actually represents a distinct, undescribed species. Herein, we formally describe this species.

MATERIALS AND METHODS

We examined a total of 16 specimens of *Gerrhonotus* from the CCB, Coahuila. All specimens were collected during fieldwork conducted in the Basin between 2008 and 2013. The specimens were fixed in 10% buffered formalin, preserved in 70% ethanol, and deposited in the herpetological collection of the Museo de Zoología of the Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC). These specimens were compared with representatives of *G. infernalis*, *G. liocephalus*, *G. lugoi*, *G. ophiurus*, and *G. cf. liocephalus* from Western Mexico (Appendix). The diagnosis is based on the specimens examined and the relevant literature (Good 1994; Bryson and Graham 2010; Lamar et al. 2015; Banda-Leal et al. 2017).

Nomenclature of scales follows Bogert and Porter (1967) and Good (1994). Scale counts were performed with the aid of a dissecting microscope. The number of transverse dorsal scale rows was determined following Campbell (1982). Measurements were taken with calipers (± 0.1 mm). In the description of the holotype, bilateral characters were scored on both the left and right sides. When the condition of a given meristic or morphometric character was not identical on both sides, the conditions on the left and right sides are reported as left/right. Scale counts and measurements for *G. farri*, *G. lazcanoii*, *G. parvus*, and *G. rhombifer* were obtained from Bryson and Graham (2010), Banda-Leal et al. (2017), and Lamar et al. (2015). Institutional codes for museum and collections follow Sabaj-Perez (2016). We adhere to the Evolutionary Species Concept of Wiley and Mayden (2000) using morphological diagnosability (i.e., the presence of exclusive morphologies) as evidence to infer the existence of distinct species.

SPECIES DESCRIPTION

Gerrhonotus mccoiji sp. nov.
(Figs. 1, 2; Table 1)

Gerrhonotus infernalis Baird 1859: Good (1994), in part.

Holotype.—MZFC 29654 (field number UOGV 1438), adult male from Poza Churince, municipality of Cuatro Ciénegas, Coahuila, Mexico ($26^{\circ}55'11.9''N$, $102^{\circ}06'53.2''W$; datum = WGS84), 739 m elevation, collected 9 September 2007 by U.O. García-Vázquez, M. Trujano-Ortega, and A. Contreras-Arquieta.

Paratypes.—Fifteen specimens; all from the municipality of Cuatro Ciénegas, Coahuila, Mexico: 13 (MZFC 29655–66, 29669) from the same locality as the holotype and two (MZFC 29667–68) from Pozas Azules, Rancho Pronatura ($26^{\circ}49'32.9''N$, $102^{\circ}01'20.9''W$; datum = WGS84), 714 m elevation.

Diagnosis.—*Gerrhonotus mccoiji* sp. nov. can be distinguished from its congeners by a combination of characters which includes the presence of a cantholoreal scale (72%; $n = 16$), a dark mark extending anteriorly from the lower temporal scales through the lower border of the orbit to the

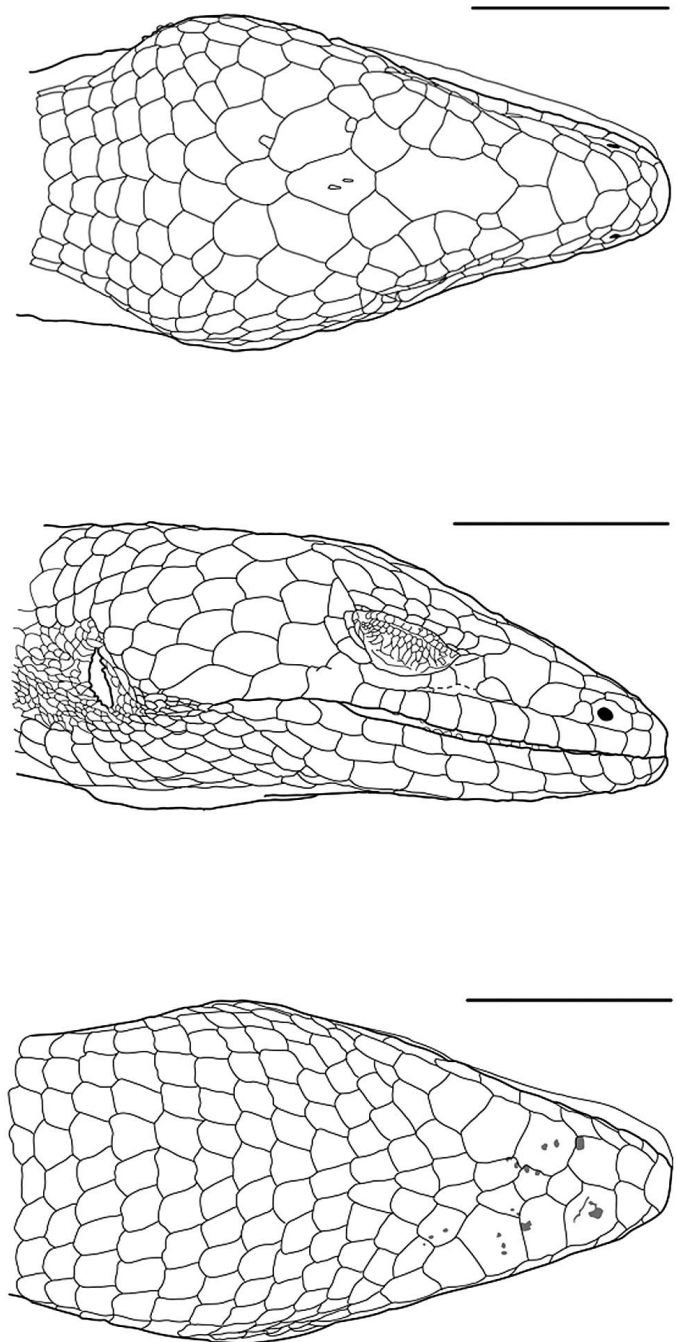


FIG. 1.—*Gerrhonotus mccoiji* sp. nov. holotype (MZFC 29654). Head scales in dorsal (top), left lateral (middle; intentionally mirrored), and ventral (bottom) views. Scale bars = 3 mm.

preocular or cantholoreal scales, keeled dorsal scales, usually (75%; $n = 16$) 7–9 dorsal cross-bands mostly interrupted or barely discernible on middorsum (few cross-bands continuous, noticeable across middorsum in some specimens; midsection of cross-bands paler, narrower than the lateral sections), usually indiscernible vertical dark bars on the lateral fold (few, faint bars occasionally present), and black flecks scattered on the venter.

Comparisons with other species (Table 2).—*Gerrhonotus mccoiji* sp. nov. can be distinguished from the other species of the genus by having black flecks scattered on the



FIG. 2.—*Gerrhonotus mccoysi* sp. nov. in life. (A) Male (paratype, MZFC 29668). (B) Female, not collected. Photographs by UOG-V and P. Heimes, respectively. A color version of this figure is available online.

venter (venter immaculate or with marks other than black flecks, or dark marks restricted to the sides of the venter in the other species [venter pale gray or pale brown, distinctly mottled with white in *G. infernalis* and *G. rhombifer*; dark marks restricted to the sides of the venter rarely present in *G. liocephalus*, *G. ophiurus*, and *G. parvus*; usually a row of small dark spots on each side of the venter in *G. cf. liocephalus* from Western Mexico—in this latter species, the dark spots tend to merge into dark longitudinal stripes in some specimens, and a gray midventral stripe is present in some specimens]). *Gerrhonotus mccoysi* sp. nov. differs from *G. farri*, *G. lazcanoi*, *G. lugoi*, *G. parvus*, and *G. rhombifer* by having keeled dorsal scales (dorsal scales smooth in the other species); from *G. farri*, *G. infernalis*, *G. lazcanoi*, *G. lugoi*, *G. ophiurus*, *G. parvus*, and *G. rhombifer* by having a dorsal body pattern usually composed of cross-bands mostly interrupted or barely discernible on middorsum (cross-bands continuous, conspicuous across middorsum present in the other species); and from *G. liocephalus*, *G. ophiurus*, and *G. cf. liocephalus* from Western Mexico by usually lacking discernible dark bars on the lateral fold (dark bars on the lateral fold prominent in the other species). *Gerrhonotus mccoysi* sp. nov. can be distinguished from all of the species of the genus, except *G. liocephalus* and *G. ophiurus*, by having a dark temporal-cantholoreal mark (dark temporal-cantholoreal mark absent in the other species [present only in young specimens, vestigial in adults, in *G. infernalis* and *G. rhombifer*; head completely black in *G. lazcanoi*]); and

TABLE 1.—Variation in selected morphometric characters in the type series of *Gerrhonotus mccoysi* sp. nov., including the holotype ($n = 16$). SVL = snout-vent length; HW = head width; HL = head length; EW = ear width; FL = forelimb length; HIL = hind limb length; TI = tibia length; DL = fourth toe length; TL = trunk length; T = tail length; SE = standard error. * = Holotype.

Specimen	Sex	Age	Trait												
			SVL	HW	HL	EW	FL	HIL	TI	DL	TL	T			
MZFC29654*	Male	Adult	122.65	15.76	24.86	3.62	26.63	37.31	13.41	8.46	72.46	265.21			
MZFC29657	Male	Adult	112.85	13.88	23.27	3.25	28.03	34.59	12.65	7.81	62.03	255.55			
MZFC29669	Male	Adult	128.63	18.01	27.94	3.65	31.58	38.86	15.15	8.69	76.97	212.25			
MZFC29663	Male	Adult	107.01	13.66	22.96	3.38	27.35	31.7	12.4	7.84	58.43	227.3			
MZFC29655	Male	Young	62.25	7.86	13.23	1.9	14.85	17.79	7.51	5.27	36.29	128.25			
MZFC29668	Male	Adult	118.36	15.38	24.79	3.47	31.73	34.65	14	8.4	67.46	200.64			
MZFC29659	Male	Adult	101.77	12.64	21.3	3.25	24.3	32.61	12.49	8.03	58.86	198.33			
MZFC29658	Male	Adult	108.92	13.87	22.64	3.06	27.64	33.45	12.51	8.18	65.42	210.44			
MZFC29660	Male	Adult	106.86	13.7	21.93	3.21	24.75	30.51	12.2	7.62	61.01	156.46			
MZFC29662	Male	Young	91.17	11.05	18.07	3.02	22.56	24.97	11.33	7	52.54	210.23			
$\bar{X} \pm 1$ SE			106 \pm 18.7	13.6 \pm 2.7	22.1 \pm 4.0	3.2 \pm 0.5	25.9 \pm 4.9	31.6 \pm 6.2	12.4 \pm 2.0	7.7 \pm 1.0	61.1 \pm 11.3	206.5 \pm 40.9			
MZFC29666	Female	Young	83.26	10.28	16.32	3.15	20.06	22.8	11.95	7.25	48.46	166.68			
MZFC29661	Female	Young	79.08	9.66	16.99	2.33	20.52	24.27	8.68	6.19	47.62	164.21			
MZFC29665	Female	Young	77.59	9.62	16.78	2.11	20.62	26.96	11.38	5.88	44.96	69			
MZFC29664	Female	Young	87.38	10.67	18.42	3.12	20.91	26.57	10	6.79	52.63	181.13			
MZFC29656	Female	Young	100.94	13.86	20.14	2.77	25.79	30.1	11.02	5.62	58.04	167.45			
MZFC29667	Female	Adult	121.17	15.75	24.13	3.33	29.27	35.03	12.3	8.77	68.31	200.34			
$\bar{X} \pm 1$ SE			91.6 \pm 26.3	11.6 \pm 3.5	18.8 \pm 5.4	4.5 \pm 2.6	22.9 \pm 6.4	32.6 \pm 9.5	10.7 \pm 3.0	6.8 \pm 1.8	53.3 \pm 15.0	156.1 \pm 57.1			

TABLE 2.—Character states for the diagnostic characters of *Gerrhonotus micoiji* sp. nov. and all of the remaining species of *Gerrhonotus*. Data for *G. farri*, *G. lazcanoi*, *G. parvus*, and *G. rhombifer* obtained from Bryson and Graham (2010), Banda-Leal et al. (2017), and Lamar et al. (2015). *n* = sample size.

Character/taxon	<i>G. micoiji</i> sp. nov.	<i>G. farri</i>	<i>G. lazcanoi</i>	<i>G. lagoti</i>	<i>G. locephaloides</i>	<i>G. ophiurus</i>	<i>G. infernalis</i>	<i>C. cf. locephaloides</i> Western Mexico	<i>G. parvus</i>	<i>G. rhombifer</i>
<i>n</i>	16	1	1	2	24	14	43	6	4	6
Venter pattern	With scattered black flecks	Immaculate	Grayish beige, distinctly mottled with white	Immaculate	Immaculate (71%) or with dark marks only on sides of venter (29%)	Immaculate (25%) or with dark marks only on sides of venter (75%)	Grayish beige, distinctly mottled with white	Dark spots on sides of venter	Immaculate	Brown, distinctly mottled with white, paraventral triangular white patches
Dark temporal-canthaloreol mark	Present	Absent	Head uniformly dark	Absent	Absent (65%) or present (35%)	Present	Present in young specimens; vestigial in adults	Absent	Absent	Present only in young specimens
Dorsal pattern	Cross-bands usually interrupted or narrow, faint on middorsum (81%)	Cross-bands conspicuous on middorsum	Cross-bands conspicuous on middorsum	Cross-bands conspicuous on middorsum	Cross-bands usually interrupted or faint on middorsum (85%)	Cross-bands conspicuous on middorsum	Cross-bands conspicuous on middorsum	Cross-bands interrupted (60%) or conspicuous on middorsum (40%)	Cross-bands conspicuous on middorsum	Cross-bands conspicuous on middorsum
Dark bars on lateral fold	Usually absent (rarely faint)	Absent	Absent	Absent	Present, prominent	Present, prominent	Absent	Present, prominent	Absent	Absent
Dorsal scales	Keel	Smooth	Smooth	Smooth	Keel	Keel	Keel	Keel	Smooth	Smooth
Number of dorsal cross-bands	7–9	12	9	10	0–8	9–11	7–11	8–9	13–14	6–8
Canthaloreol scales	Usually present (72%)	Absent	Absent	Absent	Usually present (80%)	Usually present (71%)	Usually absent (92%)	Usually present (75%)	Present	Absent

from *G. farri*, *G. infernalis*, *G. lazcanoii*, and *G. lugoi* by usually having a cantholoreal scale (cantholoreal scale usually absent [92%, $n = 39$] in *G. infernalis*, and absent in the other species).

Description of holotype (Fig. 1).—Adult male with both hemipenes partially everted. Head scales flat, smooth. Snout bluntly rounded in dorsal view, truncate in lateral view. Rostral $\sim 1.5 \times$ wider than tall, bordered posteriorly by one medial postrostral and one anterior internasal on each side of postrostral. Postrostral kite-shaped, $1.3 \times$ wider than long, in narrow contact anteriorly with rostral, broad contact anterolaterally with anterior internasal and posterolaterally with supranasal on each side, and narrow contact posteriorly with posterior internasals. Anterior internasals approximately as wide as, and slightly shorter than, postrostral, each in contact laterally with first supralabial and nasal, and posteriorly with postrostral and supranasals. Supranasals $1.2 \times$ wider than long, obliquely oriented, separated medially from each other by postrostral. Posterior internasals larger than supranasals, obliquely oriented, each in broad contact laterally with supranasal and upper postnasal, posterolaterally with canthal, and posteriorly with frontonasal. Frontonasal $1.5 \times$ wider than long, in contact laterally with canthal on either side and posteriorly with prefrontals. Prefrontals $1.2 \times$ wider than long, in narrow and broad contact laterally with canthal and cantholoreal, respectively; in contact posteriorly with first median supraocular, one small scale between first median supraocular and frontal, and frontal. Frontal $2.1 \times$ longer than wide, in contact laterally with one small scale between prefrontal and second median supraocular, second and third median supraoculars, and frontoparietal on either side, and posteriorly with interparietal. Frontoparietals approximately as wide as long, each in contact laterally with third and fourth median supraoculars, posterolaterally with upper primary temporal, and posteriorly with parietal. Median supraoculars 5/5; first $1.9 \times$ longer than wide; second as wide as long; third, fourth, and fifth $1.2\text{--}1.6 \times$ wider than long; lateral supraoculars 3/3, much smaller than median supraoculars. Interparietal $1.3 \times$ longer than wide, kite-shaped, enclosed by frontoparietals, parietals, and interoccipital; pineal eye poorly defined, situated on its posterior half. Parietals $1.1 \times$ longer than interparietal, in contact anterolaterally with upper primary temporal, posterolaterally with a larger upper temporal (presumably representing fused upper secondary and upper tertiary temporals), posteriorly with occipital, and posteromedially with interoccipital. Two rows of postoccipitals; transverse scale rows on each side of postoccipitals extending laterally to upper margin of ear.

Nasals elongate antero-posteriorly, with naris situated posteriorly; separated from rostral by anterior internasal. Postnasals 2/2, subequal in size; lower ones in narrow and broad contact with second and third supralabials, respectively. Canthus rostralis rounded. Canthals 1/1, slightly longer than wide. Loreals 1/1, slightly wider than long, slightly larger than canthals. Cantholoreals 1/1, about as large as canthal and loreal combined, in contact anteriorly with canthal and loreal, posteriorly with first superciliary and upper preocular, and ventrally with fourth and fifth supralabials on left side and fifth supralabial on right side. One roughly triangular scale between cantholoreal, upper preocular, and supralabials on either side. Preoculars 1/1,

approximately as wide as long; suboculars 2/2, anterior one slightly longer than wide, posterior one longitudinally elongate; postoculars 3/3. Superciliaries 7/7; first superciliary larger than remaining superciliaries. Supralabials 13/13; last three much larger and higher than anterior ones. Temporal scales in five rows. Primary temporals 4/4, lower primary temporal in contact with 11th and 12th supralabials on either side. Upper secondary and upper tertiary temporals presumably fused into one large scale in dorsal contact with parietal and occipital on either side; 3/3 and 4/4 secondary and tertiary temporals, respectively, extending ventrally from presumably fused upper secondary and upper tertiary temporal scales. Lower secondary and lower tertiary temporals in contact with 12th and 13th and 13th supralabials, respectively, on either side.

Mental approximately $1.5 \times$ wider than long. Infralabials 12/11. Two postmentals. Six pairs of chinshields; those of first pair in broad contact with each other, those of second and third pairs separated by one and two scales, respectively.

External ear opening oval, vertically elongate (maximum width = 0.8 mm, maximum height = 3.0 mm), without lobules or spines. Dorsal scales keeled, imbricate, nearly equal in size to ventrals; in 10 longitudinal rows on neck and 14 rows at level of midbody; in 47 transverse rows from first row of nuchals to last scale row lying at least partially over posterior portion of thighs. Lateral fold well developed. Ventral scales in 40 transverse rows from anterior insertion of forelimbs to vent; in 12 longitudinal rows at level of midbody. Medial pair of preloacal scales nearly twice as large as lateral preloacal scales. Scales on dorsal surface of forelimbs smooth except for some faintly keeled scales on arms; scales on anterodorsal surface of thighs and dorsal surface of shanks smooth. Supradigital scales in one row; subdigital lamellae rounded. Subdigital lamellae on manus I 7/8, II 11/11, III 14/13, IV 16/17, V 11/11. Subdigital lamellae on pes I 8/7, II 12/12, III 15/14, IV 18/18, V 12/12. Hemipenes bifurcate distally.

Color in preservative.—Head, body, limbs, and tail ground color light brown dorsally and laterally, white ventrally. Head immaculate dorsally and laterally except for one dark brown spot on anteroventral corner of lower primary temporal scale on each side, one dark scale on temporal region on right side, and another one on nuchal region on left side. Body with eight dark, dorsal cross-bands; one at level of midneck and seven between levels of anterior insertion of arms and groin; cross-bands heterogeneous; their midsection narrower and paler than lateral sections, composed of two or three often fragmented rows of intermingled white, pale brown, or dark brown scales; their lateral sections wider, overall darker, usually composed of 2–4 (occasionally 5) short scale rows checkered with white, dark brown, and black scales; cross-bands separated from each other by 2–3 transverse scale rows. Lateral fold white; vertical dark bars indiscernible except for few (<5), barely perceptible, poorly defined bars on each side. Thighs with few, small, irregular dark spots on anterodorsal surface. Tail with four dark, dorsal cross-bands on anterior end; first at level of posterior insertion of legs, remaining ones separated from each other by two scale rows; each cross-band composed of three scale rows checkered with white, pale brown, and dark brown scales; first cross-band conspicuous; remaining ones gradually becoming fainter posteriorly.

Ventral surface of head, body, limbs, and tail immaculate white except for some irregular, scattered black flecks on belly.

Variation.—This section is based on all of the paratypes. Multistate characters: Postrostral separated from posterior internasal by supranasal on right side in MZFC 29660; separated from posterior internasals by one tiny scale in MZFC 29660. Supranasal divided on right side in MZFC 26667. Cantholoreal absent on both sides in four specimens, absent on left side in MZFC 29664. Upper primary temporal in contact with first supraocular on left side in MZFC 29665. Meristic characters: Canthals 1–3, $\bar{X} = 1.5$ (1/1 [$n = 7$], 1/2 [$n = 1$], 2/1 [$n = 1$], 2/2 [$n = 5$], 3/2 [$n = 1$]); loreals 1–3, $\bar{X} = 1.5$ (1/1 [$n = 3$], 2/2 [$n = 9$], 3/2 [$n = 1$], 3/3 [$n = 2$]); superciliaries 6–8, $\bar{X} = 6.5$ (6/6 [$n = 5$], 6/7 [$n = 3$], 7/6 [$n = 2$], 7/7 [$n = 4$], 8/7 [$n = 1$]); supralabials 12–13, $\bar{X} = 12.7$ (12/12 [$n = 1$], 12/13 [$n = 3$], 13/12 [$n = 4$], 13/13 [$n = 7$]); preoculars 1–2, $\bar{X} = 1.1$ (1/1 [$n = 13$], 1/2 [$n = 1$], 2/2 [$n = 1$]); suboculars 1–3, $\bar{X} = 2.1$ (1/2 [$n = 1$], 2/2 [$n = 10$], 2/3 [$n = 4$]); postoculars 3–4, $\bar{X} = 3.1$ (3/3 [$n = 12$], 3/4 [$n = 2$], 4/4 [$n = 1$]); primary temporals 4–5, $\bar{X} = 4.2$ (4/4 [$n = 10$], 4/5 [$n = 3$], 5/4 [$n = 2$]); secondary temporals 3–4, $\bar{X} = 3.1$ (3/3 [$n = 13$], 3/4 [$n = 2$]). Longitudinal dorsal scale rows 16 in all specimens; transverse dorsal scale rows 45–49, $\bar{X} = 47.1$; lamellae under fourth toe 17–21, $\bar{X} = 18.9$ (17/18 [$n = 2$]; 17/19 [$n = 1$]; 18/19 [$n = 3$]; 18/20 [$n = 4$]; 19/19 [$n = 1$]; 19/20 [$n = 1$]; 19/21 [$n = 1$]; 20/20 [$n = 1$]; 21/21 [$n = 1$]).

Color pattern (in preservative).—This section is based on all of the paratypes unless noted otherwise. The head, body, limbs, and tail ground color was pale to medium brown on the dorsal and lateral surfaces. A dark brown mark on the side of the head was present in all of the specimens ($n = 14$; MZFC 29656 damaged); however, it was highly variable in distinctness and extent. Usually, the mark consisted of a dark brown spot on the anteroventral corner of the lower primary temporal (gradually becoming diffuse on the rest of the scale) that extended anteriorly through the lower postocular, then narrowed into a thin line along the dorsal margin of the suboculars, and broadened again into a diffuse splotch on the upper portion of the preocular. The mark was usually evident on the lower primary temporal and lower postocular, but became barely perceptible on the dorsal margin of the suboculars and upper portion of the preocular in most of the specimens. The mark further extended to the cantholoreal in three specimens (MZFC 29655, 29662, and 29664), to the lower secondary temporal in MZFC 29668, to the cantholoreal and the dorsal margin of the supralabials adjacent to the lower primary temporal in MZFC 29661, and (if faintly) to the cantholoreal and the middle of the lower secondary temporal in MZFC 29666. In addition, the mark was barely discernible on the lower postocular on the left side in MZFC 29667, absent on the lower postocular on the right side in MZFC 29669, absent on the lower primary temporal on the left side in MZFC 29657, and absent on the lower primary temporal on the right side in MZFC 29663. A small, dark brown spot was present on the posterodorsal corner of the temporal region in 10 specimens (MZFC 29658–63 [absent on left side in MZFC 29663] and MZFC 29665–68).

Dorsal cross-bands 7–9 ($\bar{X} = 8.1$). Most or all of the cross-bands were continuous across the dorsum (their mid portion composed of 2–3 scale rows checkered with pale and dark brown scales, often flecked with white) in three specimens

(MZFC 29667–69); there were no, or only few (usually 2–3, occasionally 4 or 5), cross-bands discernible across the dorsum (their mid portion usually composed of a single row of pale brown scales, thus rendering the middorsum distinctly paler than the flanks) in the remaining specimens. The chest and venter exhibited from few to numerous scattered black flecks (faint in MZFC 29655).

Etymology.—The species epithet is a noun in the genitive case and a patronym for the late Clarence Jack McCoy in recognition of his many and significant contributions to the knowledge of the amphibians and reptiles from the Cuatro Ciénegas Basin.

Distribution and ecology.—*Gerrhonotus mccoiji* sp. nov. is known only from the shores of several small lagoons in the Cuatro Ciénegas Basin, Coahuila (Fig. 3). The vegetation on the Cuatro Ciénegas Basin was described by Pinkava (1979, 1984) as composed of grasslands, sedges, and marshes, gypsum dune assemblages, desert scrub, and chaparral. The climate at the type locality is temperate (mean annual temperature = 21.4°C; mean temperatures of the coldest and warmest months are 12°C and 28°C, respectively) and arid, with annual seasonal precipitation averaging <200 mm, and a rainy season that extends from May through December (Instituto Nacional de Estadística, Geografía e Informática [INEGI] 1994). All specimens of this species were collected at night, when most of them were active on the vegetation around the pools at heights of up to 2 m (Fig. 4a). The activity of this species appears to be restricted to the period of the summer with the highest precipitation (between June and September).

Conservation.—The conservation status of the CCB lagoons has long been a matter of concern (i.e., Pinkava 1987; Breunig 2006). Currently, the Basin is considered the continent's second-smallest freshwater ecoregion (492 km²). Because of its large number of unique (endemic) organisms and the imminent threats to their existence, it is classified, along with only 11 of North America's 76 freshwater ecoregions, in the First Priority class for conservation action by the World Wildlife Fund (Abell et al. 2000). Agricultural development and associated water extraction in the region have placed pressure on the ecological integrity of this unique ecosystem (Souza et al. 2006). Water extraction has significantly reduced the amount of habitat available for the endemic species of amphibians and reptiles that are closely associated with the humid zones in the Basin (McCoy 1984), which has reduced their distribution within the Basin (García-Vázquez et al. 2010). Unless urgent conservation strategies are implemented to regulate water extraction in the CCB, many species in the Basin could disappear.

DISCUSSION

Good (1994) regarded the brief description of *Gerrhonotus liocephalus aguayoi* provided by Contreras-Arquieta as questionable because it appeared only in an abstract for a 1989 scientific conference. In addition, because no type material of *G. l. aguayoi* was designated, the populations referable to this taxon were unclear, and Good (1994) did not include it in his study. Furthermore, whereas the aforementioned description by Contreras-Arquieta suggested that *G. l. aguayoi* differed from *G. l. infernalis* by the presence of a cantholoreal scale, dorsal cross-bands with black anterior and posterior margins,

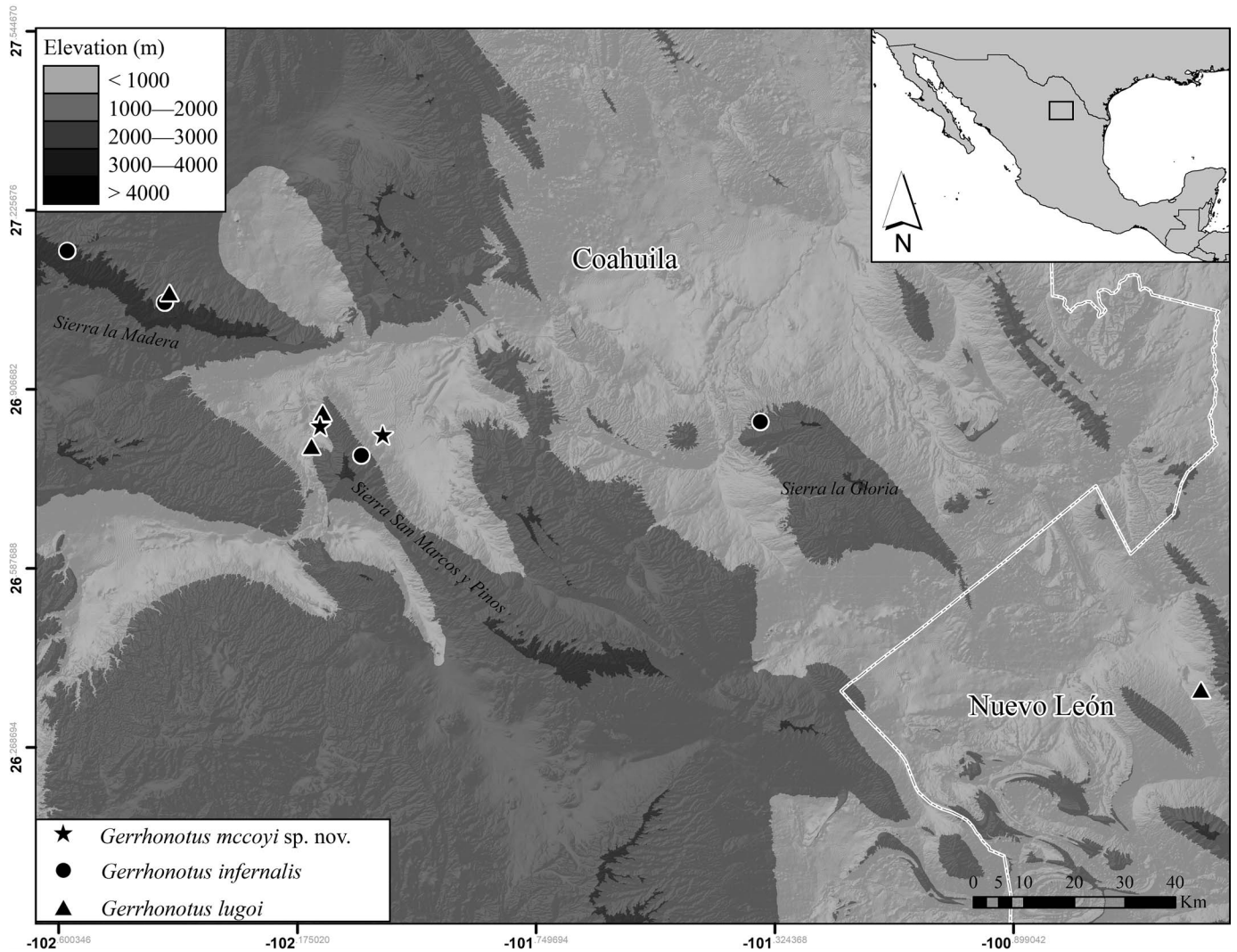


FIG. 3.—Collecting localities of *Gerrhonotus mccoysi* and other species of *Gerrhonotus* distributed in central Coahuila, México (inset). White line represents state boundaries.

and black flecks on the venter, Good (1994:198) stated that some (but not all) of the specimens from central Coahuila that he examined had a color pattern “. . .reminiscent of the brief description provided by Contreras-Arquieta,” but that all of them had the canthal/loreal condition characteristic of *G. infernalis*. Thus, Good (1994) regarded the evidence to warrant taxonomic recognition of *G. liocephalus aguayoi* as insufficient and assigned the populations of *Gerrhonotus* from central Coahuila to *G. infernalis*.

Examination of additional specimens of *Gerrhonotus* from the CCB revealed that all of them have a ventral color pattern similar to that described by Contreras-Arquieta for *G. liocephalus aguayoi*, a pattern different from that of all the other species of *Gerrhonotus* (Fig. 4). Also, most (72%) of the specimens from the CCB possess a canthaloreole scale, which is usually absent in *G. infernalis* (Good 1994). Whereas this indicated that the population in the CCB does represent a distinct, independent lineage from *G. infernalis* and all of the other known species in the genus, it was intriguing that Good (1994) found the diagnostic characters

of *G. l. aguayoi* only in some of his specimens from central Coahuila. This might be explained by Good's (1994:198) sample from “central Coahuila” which was composed of five specimens from the CCB and nine from the surrounding mountains. Unlike the specimens of the CCB, those from the Sierra La Madera and Sierra San Marcos y Pinos mountain ranges do exhibit the diagnostic characters of other populations of *G. infernalis* sensu Good (1994). Thus, it appears that Good's (1994) central Coahuila sample simply was composed of both specimens of *G. infernalis* and *G. mccoysi* sp. nov.

Even though they occur in apparent geographic proximity, *G. mccoysi* sp. nov. and *G. infernalis* are allopatric, as *G. mccoysi* sp. nov. is restricted to the halophytic vegetation along the water bodies in the lowest areas of the valley, below 750 m elevation (Fig. 4a), whereas *G. infernalis* is restricted to the higher slopes of the mountain ranges surrounding the CCB where it inhabits oak and pine–oak forests above 1300 m elevation (Fig. 4b). *Gerrhonotus lugoi*, the other species in the Cuatro Ciénegas region, is



FIG. 4.—Habitat and color pattern in life of species of *Gerrhonotus* in the Cuatro Ciénegas region, México. (A) *G. mccoyi* sp. nov. (B) *G. infernalis*. (C) *G. lugoi*. Photographs of habitats and specimen of *G. infernalis* by UOG-V; those of specimens of *G. mccoyi* sp. nov. and *G. lugoi* by P. Heimes and J. Jones, respectively. A color version of this figure is available online.

distributed at elevations intermediate between the elevational ranges of the two other species, and it is found in rocky habitats where xerophytic scrub is the dominant vegetation (Fig. 4c; McCoy 1970).

In a recent multilocus phylogeny of the genus *Gerrhonotus* (García-Vázquez et al. 2018), the four included samples of *G. mccoyi* sp. nov. and formed a strongly supported clade. *Gerrhonotus infernalis* was paraphyletic with respect to *G. mccoyi* sp. nov., however, and the latter taxon was the sister taxon of the samples of *G. infernalis* from Texas and Nuevo León and not of the closest population of *G. infernalis* (from Sierra la Madera). Thus, we consider that the paraphyly of *G. infernalis* is likely attributable to incomplete lineage sorting.

Interestingly, a similar pattern is known for lizards of the genus *Scincella*: in a mitochondrial phylogeny of the *S. oligosoma* group, *S. lateralis* was paraphyletic with respect to *S. kikaapoa*, a species endemic of the CCB (García-Vázquez 2012).

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RESUMEN: Se describe una especie nueva de *Gerrhonotus*, previamente confundida con *G. infernalis*, de la Cuenca de Cuatro Ciénegas, Coahuila, México. La especie nueva se conoce sólo de la localidad tipo y se caracteriza por la siguiente combinación de caracteres: escama cantoloreal usualmente presente, una marca oscura que se extiende anteriormente desde las escamas temporales inferiores a través del borde inferior de la órbita hasta la escama preocular o cantoloreal, escamas dorsales aquilladas, patrón de coloración dorsal del cuerpo usualmente compuesto de bandas transversales típicamente interrumpidas o apenas visibles en la parte media del dorso, barras oscuras verticales en el pliegue lateral usualmente no discernibles (algunas barras tenues ocasionalmente presentes), y manchas negras pequeñas dispersas en el vientre. La especie nueva es geográficamente más cercana a *G. lugoi* y *G. infernalis*, pero morfológicamente más similar a *G. infernalis*.

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APPENDIX

Specimens Examined

Institutional codes for museum and collections follow Sabaj-Perez (2016).

Gerrhonotus infernalis.—MEXICO: COAHUILA: Ejido La Casita, Sierra la Concordia (MZFC 32946); Sierra de Jimulco, La Flor de Jimulco, Torreón (MZFC 32947, 32959); Sierra de Jimulco, El Chivo, Viesca (MZFC 32948–49); Rancho La Casita, Sierra la Madera (MZFC 32951–53); Rancho El Chupadero, Sierra La Madera (MZFC 32954). GUANAJUATO: 5 km E San Miguel de Allende (MZFC 32955). HIDALGO: Zoquizoquiapan (MZFC 4875); Zimapán (MZFC 7776). NUEVO LEON: Monterrey (MZFC 4697); 5.3 km S La Poza, near Santa Clara (MZFC 7465); 2 km W Horsetail Falls, 14 km W Santiago on road to Laguna Sánchez (MZFC 11219); Rancho El Manzano, road Santiago-Laguna Santiago (MZFC 32956); 1.3 mi La Ciénega (MZFC 745). QUERETARO: Cadereyta de Montes, 4 km NE by road to Rancho El Arbolito (MZFC 8010–11); Cadereyta de Montes (MZFC 7825–27, 8012–13); Cadereyta de Montes, La Nopalera (MZFC 6378); Cadereyta de Montes, Mesa de León (MZFC 7777); Chichimequillas, Nueva El Marqués (MZFC 7043). SAN LUIS POTOSÍ: Guadalcázar, Las Lagunas (MZFC 33392). TAMAULIPAS: Miquihuana, 7 km by road from La Peña-Joya Pelona (MZFC 8429). UNITED STATES: TEXAS: 18.0 mi S of Rocksprings, at polecat E fork Nueces River (UTA 36094); 40.5 mi NNE Dryden, head of Piston canyon (UTA 2024); 6.3 mi NE of Wimberly (UTA 1613); Austin (UTA 54603); Austin: Zilcher Park (UTA 53287); Boerne (UTA 54600); ca. 8 km NW Boerne (UTA 25909); City of Austin, Mayfield Park near Mount Bonell (MZFC 6758); Clarendon

Drive and Cumberland Street (UTA 44263); FM 337, 9.0 km W jct FM 187 (UTA 25905–06); Gorman Falls (UTA 30850); Hunt (UTA 44264); N side Austin, near Decker Lake (UTA 25910).

Gerrhonotus liocephalus.—MEXICO: ESTADO DE MEXICO: Villa de Guerrero, Rancho el Tejocote (MZFC 5030–31). GUERRERO: Vallecitos (MZFC 20366). OAXACA: 3 km E Guelatao (MZFC 32957); 16 km N El Jicaro (MZFC 6999); Road Santa Maria Guienagati-Santiago Lachiguiri (MZFC 16988); Ramón Escobar Balboa (MZFC 33389); Rodolfo Figueroa (MZFC 33390–91); Cerro Baúl, 19 km NW Rizo de Oro (UTA 8784, 12224, 30328); El Tejocote (UTA 6065, 6104, 10226, 12221, 19681, 22564, 22573, 30849); Huautla de Jiménez, Puerto de La Soledad (MZFC 13233). PUEBLA: 1 mi N Cacaloapan (UTA 4715); 4 km N San Juan Tepanco (MZFC 7829–30).

Gerrhonotus lugoi.—MEXICO: COAHUILA: Cuatro Ciénegas, Mountains N Nueva Atalaya (MZFC 23318, 27351).

Gerrhonotus ophiurus.—MEXICO: HIDALGO: Meztlán, 1 km N de Zoquizoquiapan (MZFC 7824, 7828); Ejido el Piñón, 15 km S Jacala (MZFC 32959); Meztlán (MZFC 5748); Tolantongo (MZFC 6341). QUERETARO: Cadereyta de Montes (MZFC 9717). SAN LUIS POTOSÍ: Km 241, road Xilitla-San Juan del Río (MZFC 5560); Xilitla (MZFC 5939, 6106). VERACRUZ: 2.0 mi NE Catemaco, N side of Lago Catemaco (UTA 3360); Catemaco (MZFC 13879); Misantla (MZFC 32960–62).

Gerrhonotus cf. *liocephalus* (Western Mexico).—MEXICO: COLIMA: Manzanillo, 1.4–2.4 km E La Central (MZFC 32963); Minatitlán, km 2.5 camino a El Terrero (MZFC 8038). JALISCO: Chamela (MZFC 8428, 32964). MICHOACÁN: Chinicuila, close to Puerto el Caimán (MZFC 14110, 32965).