



## Taxonomic review of the rare Mexican snake genus *Chersodromus* (Serpentes: Dipsadidae), with the description of two new species

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### Abstract

*Chersodromus* is an endemic Mexican genus of snakes characterized by fused prefrontals shield. Only two species were previously known within the genus, *C. liebmanni* and *C. rubriventris*. We describe two new congeners, one from the Sierra Madre Oriental of northern Puebla and another from the Atlantic lowlands of the Chimalapas region in southeastern Oaxaca. These new species can be clearly differentiated on the basis of their morphology. Diagnostic characters distinguishing congeners include the number of dorsal scale rows, supralabials, and infralabials contacting anterior chinshields; whether or not the mental contacts the first pair of chinshields; and the coloration of the belly. We provide hemipenal descriptions of three species for which males are known.

**Key words:** external morphology, Hemipenis, Puebla, Chimalapas, Oaxaca

### Resumen

*Chersodromus* es un género endémico de México que se caracteriza por poseer las escamas prefrontales fusionadas. Solo dos especies eran previamente conocidas dentro del género, *C. liebmanni* y *C. rubriventris*. Describimos dos nuevas especies, una de la Sierra Madre Oriental del norte de Puebla y otra de las tierras bajas del Atlántico en la región de los Chimalapas, al sureste de Oaxaca. Estas nuevas especies se pueden diferenciar claramente con base en su morfología. Caracteres diagnósticos que las distinguen de sus congéneres son el número de escamas dorsales, supralabiales, e infralabiales en contacto con los escudos geniales anteriores; la mental puede o no estar en contacto con el primer par de escudos geniales; y la coloración del vientre. Proporcionamos descripciones de los hemipenes de tres especies de las cuales los machos son conocidos.

**Palabras clave:** Morfología externa, Hemipenis, Puebla, Chimalapas, Oaxaca

### Introduction

Endemic Mexican snakes of the genus *Chersodromus* Reinhardt (1861) have remained relatively rare in collections. These moderately sized snakes are characterized by a fused prefrontal shield. Previously, two species were recognized in the genus, both occurring in montane forest of the Atlantic Versant of the Sierra Madre Oriental.

*Chersodromus liebmanni* occurs in central Veracruz and northern Oaxaca, whereas *C. rubriventris* inhabits Atlantic Versant slopes of the Sierra Madre Oriental in a small region where the states of San Luis Potosí, Querétaro, and Hidalgo come together (Fig. 1). *Chersodromus liebmanni* was described by Reinhardt (1861) and this genus was considered monotypic for about a century. *Chersodromus rubriventris* was described as *Schmidtophis rubriventris* by Taylor (1949) on the basis of a single specimen from Xilitla, San Luis Potosí.

Subsequently, Dixon & Ketchersid (1969) reported a second specimen and considered *Schmidtophis*, a junior synonym of *Chersodromus*. Zweifel (1954), described *C. nigricans* from Guerrero, however, Scott (1967) placed this name into the synonymy of *Tropidodipsas annulifera*.

There is scant information published about the genus *Chersodromus*. McCoid *et al.* (1980) reported the third specimen of *C. rubriventris* from El Madroño, Querétaro. Canseco-Márquez & Flores-Villela (1995) and Mancilla-Moreno & Camarillo (1998) provided new localities for *C. liebmanni* in northern Oaxaca. Recently, Ramírez-Bautista *et al.* (2013) reported three additional specimens of *C. rubriventris* from the state of Hidalgo, representing a new record for this species from the state and they included information about morphological variation and natural history. On the basis of mitochondrial and nuclear data, Ingrasci (2011) and Sheehy (2012), suggested a close affinity between the genera *Chersodromus* and *Ninia* Baird & Girard 1853.

Based on fieldwork conducted in northern Puebla and remote parts of the Chimalapas region of Oaxaca, individuals belonging to the genus *Chersodromus* were collected at localities from where this genus was previously unknown. The presence of apparently exclusive morphological features, geographical distribution, and distinct differences in habitats indicate these newly collected specimens represent two undescribed species. We have compared these two new populations with all available specimens in New World collections.

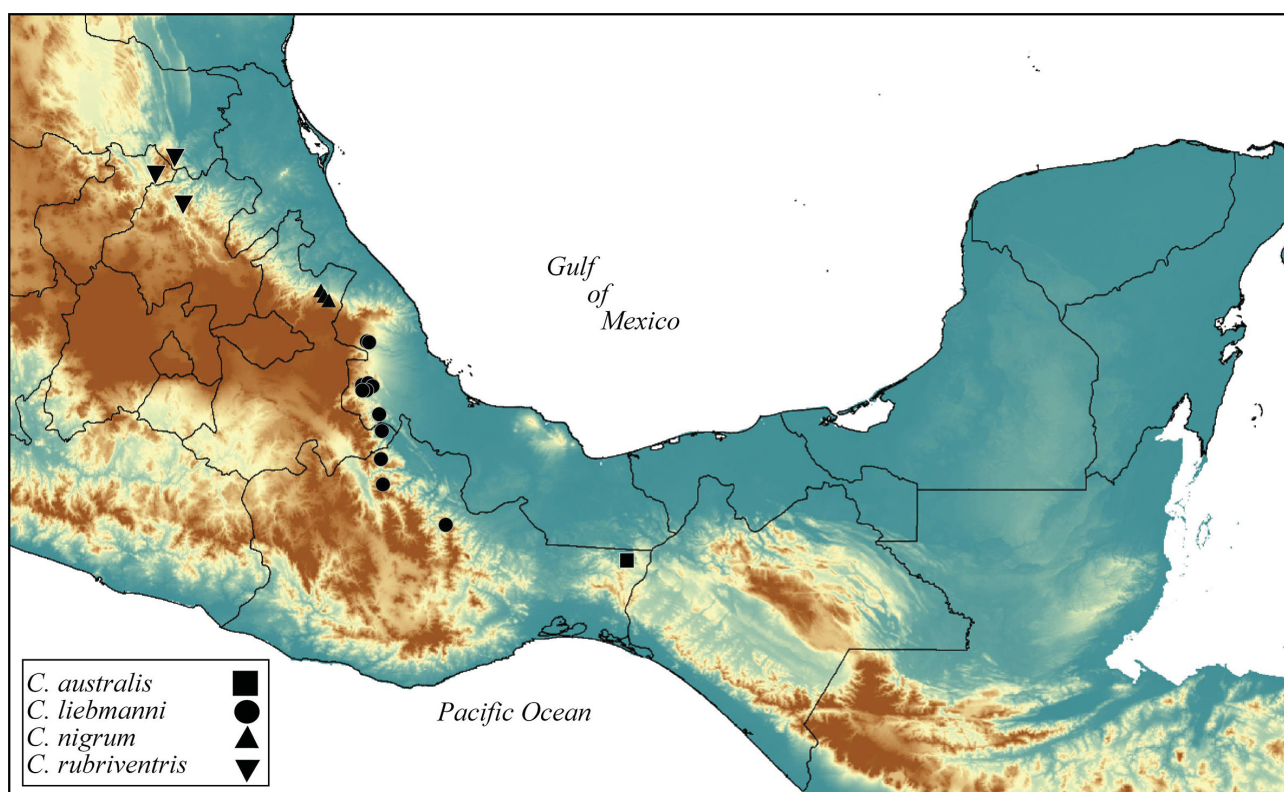


FIGURE 1. Geographic distribution of the currently recognized species of the genus *Chersodromus*.

## Material and methods

Institutional abbreviations of the specimens examined (Appendix I) are as listed in Sabaj Pérez (2016), except for Centro de Investigaciones Biológicas (CIB), Hidalgo, Mexico and Instituto Tecnológico Superior de Zongolica, Veracruz, Mexico (ITSZ). Scale counts were made with the aid of a dissecting microscope. When the condition of a given character was not identical on both sides, the conditions on the left and right sides are given (L/R). Measurements were taken with digital calipers to the nearest 1.0 mm. We measured head length from the tip of snout to angle of jaw. All scale dimensions were measured at their maximum length or width. Standard abbreviations were used for snout-vent length (SVL) and tail length (TL). We describe two new species of *Chersodromus*, provide species accounts for the rare *C. liebmanni* and *C. rubriventris*, and offer an identification key for the genus. For examination of dentitional characters, one maxilla was removed and placed in a dilute



solution of Proteinase K for approximately one hour. The right hemipenis of adult males were removed at their base and prepared following the procedures of Myers & Cadle (2003), Zaher & Prudente (2003) and Angarita-Sierra (2014). Hemipenial terminology follows Dowling & Savage (1960), Myers (1974) and Myers & Campbell (1981).

## Results

Firstly, the original descriptions of three taxa now considered to be synonyms of *Chersodromus liebmanni* were carefully checked. The author of the name *Chersodromus* is Reinhardt (1861), who diagnosed this genus as having a single prefrontal shield, postocular fused with supraocular, and 17 rows of keeled dorsal scales. He further diagnosed *C. liebmanni* as having a cream venter and *C. nigricans* as being similar to *C. liebmanni*, differing only in minor scale proportions and in not having a pale collar. The latter character is unusual; all species of *Chersodromus* have a pale collar, and Reinhardt's specimen may be been darkened owing to preservative or may have represented an unusual individual variant, but regardless represents *C. liebmanni* based on all pholidosis characteristics and overall habitus. The description of *Opisthiodon torquatus* Peters (1861) likewise agrees with *C. liebmanni* and furthermore was collected near "Huanusco" [=Huatusco], Veracruz, an known locality for *C. liebmanni*. Finally, the description of *Dirosema collare* Werner (1900) agrees well with *C. liebmanni*. His figures (Werner 1900: figs. 3–5) clearly show the postocular and supraocular are fused and the mental and anterior chinshields are in contact with each other, traits possess only by *C. liebmanni* and *C. nigrum*. However, he clearly states that the venter of his snake is yellow, with some darker mottling on gular region and posterior part of the body, in perfect agreement with *C. liebmanni*, but not *C. nigrum*, which has a mostly black ventral surface (see Table 1).

## Taxonomic account

### *Chersodromus liebmanni* Reinhardt, 1860

Fig. 2, 3A, Table 1

*Chersodromus liebmanni* Reinhardt, 1861, Vidensk. Meddel. Naturhist. Foren. Kjöbenhavn 2:243. Holotype: ZMUC 60561.

Type-locality: "Mexico." Restricted to Cuautlapan, Veracruz, Mexico, by Smith & Taylor (1950:347), and to Mirador, Veracruz, Mexico by Smith & Braestrup (1963:240).

*Chersodromus nigricans* Reinhardt, 1861 Vidensk. Meddel. Naturhist. Foren. Kjöbenhavn 2:245. Holotype: ZMUC 60562.

Type locality: "Mexico." Restricted to Cuautlapan, Veracruz, Mexico, by Smith & Taylor (1950:347), and to Mirador, Veracruz, Mexico by Smith & Braetrup (1963:240).

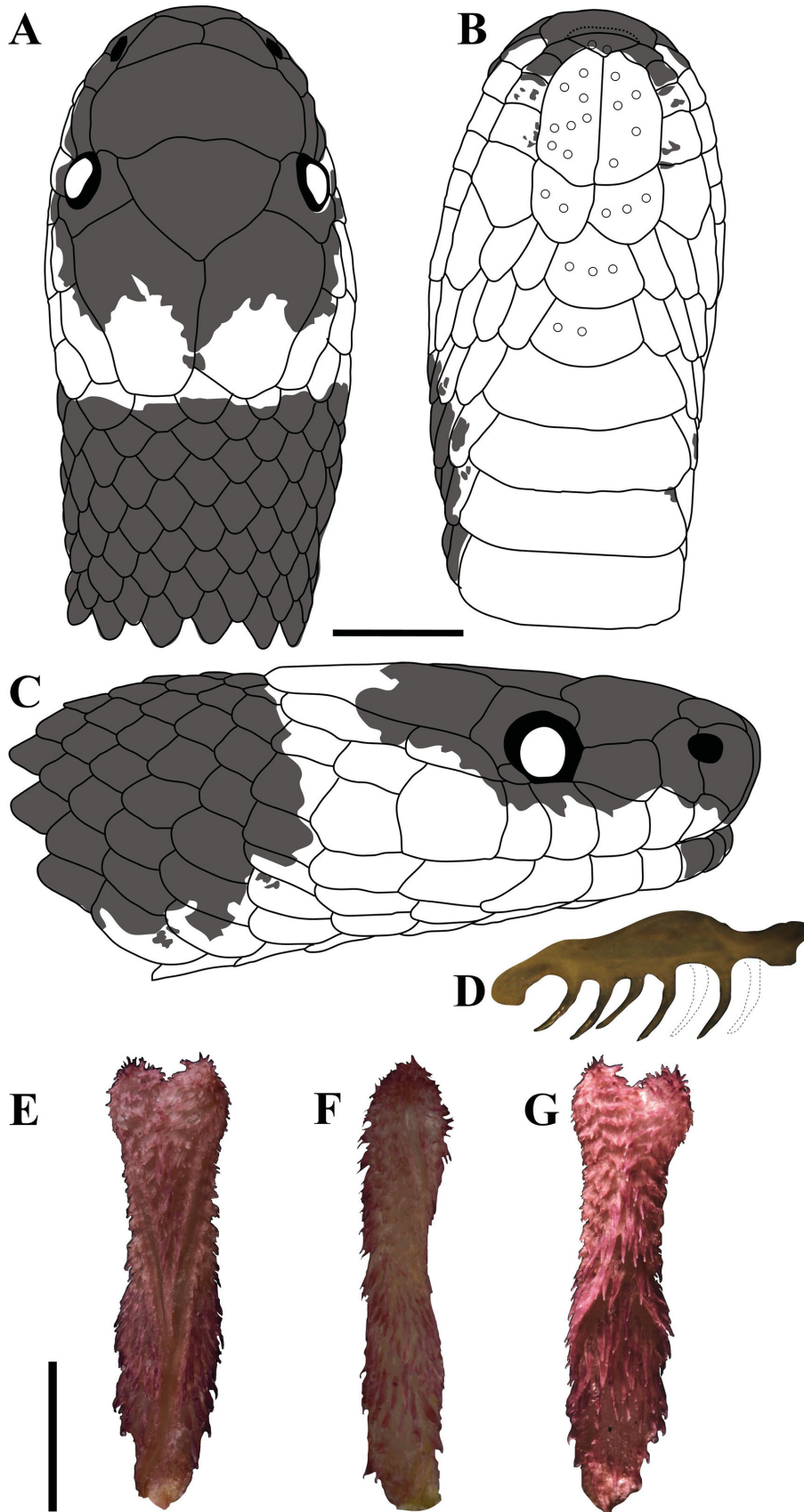
*Opisthiodon torquatus* Peters, 1861, Monatsber. königl. Akad. Wiss. Berlin. 1861:461. Holotype: Berlin Museum. Type locality: Huanusco [= Huatusco], Veracruz.

*Dirosema collare* Werner 1900, Zool. Anz. 23:197. Holotype: Not traced. Type-locality: Mexico.

**Diagnosis.** *Chersodromus liebmanni* can be distinguished from all Mexican species of snakes by having combination of prefrontals fused into single scale; postocular fused with supraocular; dorsal scales keeled in 17 rows at midbody, unreduced posteriorly; supralabials 7, third and fourth entering orbit; infralabials 7–8, usually 1–5 contacting anterior chinshields (5 narrowly); mental contacting anterior chinshields; venter cream colored.

This species may be distinguished from all species of *Chersodromus*, except *C. rubriventris*, by having the postocular fused with supraocular; from *C. rubriventris* by having 17 scales around body (vs. 15), ventral surface uniformly cream (vs. bright orange) (Table 1). *Ninia diademata* Baird & Girard (1853) might be confused with this species, and they are sympatric at some localities in Oaxaca and Veracruz. *Ninia diademata* differs from *Chersodromus* in having paired prefrontals shields, 19 strongly keeled dorsal scale rows, and two postoculars, larger body size (reaching at least 330 cm TL), and more slender tail.

**Description.** Small, slender snake; head moderately wider than the neck. Adults commonly reaching 250–330 mm in total length with the largest known male 310 mm, and the largest female 330 mm. Tail comprises 16–22% of total length in males, 15–18% in females.



**FIGURE 2.** Dorsal (A), ventral (B) and lateral (C) views of the head (Scale = 3 mm); right maxilla (D, 2.61 mm); and from left to right: sulcate, lateral, and asulcate views of the hemipenis (E–G, Scale = 3.9 mm) of *Chersodromus liebmanni* (MZFC 28687).





**FIGURE 3.** Adult of *Chersodromus liebmanni* in life (MZFC 28687) from Totontepec, Oaxaca (A), and its locality in Cuautlapan, Veracruz (B).

Prefrontals fused into a single, large scale. Supraoculars fused with postoculars. Frontal relatively broad and nasals divided. Small internasals 1/1, loreals 1/1, extending from the postnasal to the anterior edge of eye (no preoculars). No discrete postoculars are present (fused with supraocular). temporals 1+2 (rarely 1+1 owing to fusion of secondary series), supralabials 6–7 (usually 7) with 3–4 entering orbit, infralabials 6–8 (usually 7) with 1–4 contacting anterior chinshields (5 usually narrowly). Mental broader than long, first pair of infralabials not in contact along ventral midline. Anterior chinshields large with posterior pair of chinshields about one-third to one-half the size and anterior pair. Dorsal scales keeled in 17-17-17 rows, rarely reduced by one either anteriorly or posteriorly. Preventrals 2 (rarely 1), ventrals 121–136 in males and 126–140 in females; divided subcaudals 32–42 in males and 31–39 in females; dorsal scale rows at midlength of tail 6–8. Cloacal scute undivided. Pupil subcircular to vertically oval.



A conspicuous yellow collar crosses the back of the head; the anterior border is irregular, usually having a middorsal forward extension to near the posterior tip of the frontal, extending on either side to involve about one-half to two-thirds of the parietals, and laterally including the posterior portion of the anterior temporal and secondary temporals and portions of last several supralabials. Posterior border of the collar relatively straight, reaching the posterior edges of the parietals or nearly so, and extending posteriorly 0.5–1 scales. Dorsum dark gray to blackish and extends to the lateral portion of ventrals and subcaudals. A black head cap extends from the rostral to the anterior portion of parietals, covering internasals, a single fused prefrontal, supraoculars and fused postoculars, nasals, loreal, anterior portion of anterior temporal, and upper portion or edges of at least supralabials 3–5. The mental and infralabials 1–4 often have dark speckling or mottling. Belly immaculate cream or with varying amounts of dark mottling, especially along the midventer. Subcaudals usually have irregular dark mottling, especially along the midventer, and often become more heavily mottled posteriorly with distal portion of tail sometimes mostly dark. In a few individuals all subcaudals are mostly dark.

**Maxillary dentition (Fig. 2 D).** Right maxilla extending anteriorly to level of suture between second and third supralabials, dorsoventrally compressed; in lateral view, anterior one-third curved dorsally; posterior end curved ventrally; maxillary teeth 7, slender, curved, longer posteriorly.

**Hemipenis morphology (Fig. 2 E–G).** Retracted organ extends to level of tenth subcaudal, slightly bilobed, and semicapitate, sulcus spermaticus centrifugal with laterally expanded margins, ornamented with numerous spines of equal size, extending to tips of lobes; sulcus spermaticus bifurcates for about half length of hemipenial body; intrasulcar region and hemipenial body covered more-or-less homogeneously by spines, but on sulcate side of base, hook-shaped spine present on the right side of the hemipenis. In sulcate view, spines organized in inverted “V” shape before reaching capitulation of hemipenis. On proximal region, two parallel folds protruding from body of hemipenis, ornamented by small spinules.

**Distribution and habitat.** Inhabiting the Atlantic foothills and versant of west-central Veracruz in the Orizaba region southward through the Sierra Zongolica to Sierra Negra in southeast Puebla and the Sierra Mixe in northern Oaxaca (Fig. 1). *Chersodromus liebmanni* inhabits upper rain forest and cloud forest (Fig. 3B) between 1000–1800 m above sea level (asl hereafter). Several specimens have been collected in agricultural fields and shade coffee plantations.

### ***Chersodromus rubriventris* (Taylor, 1949)**

Fig. 4, 5A, Table 1

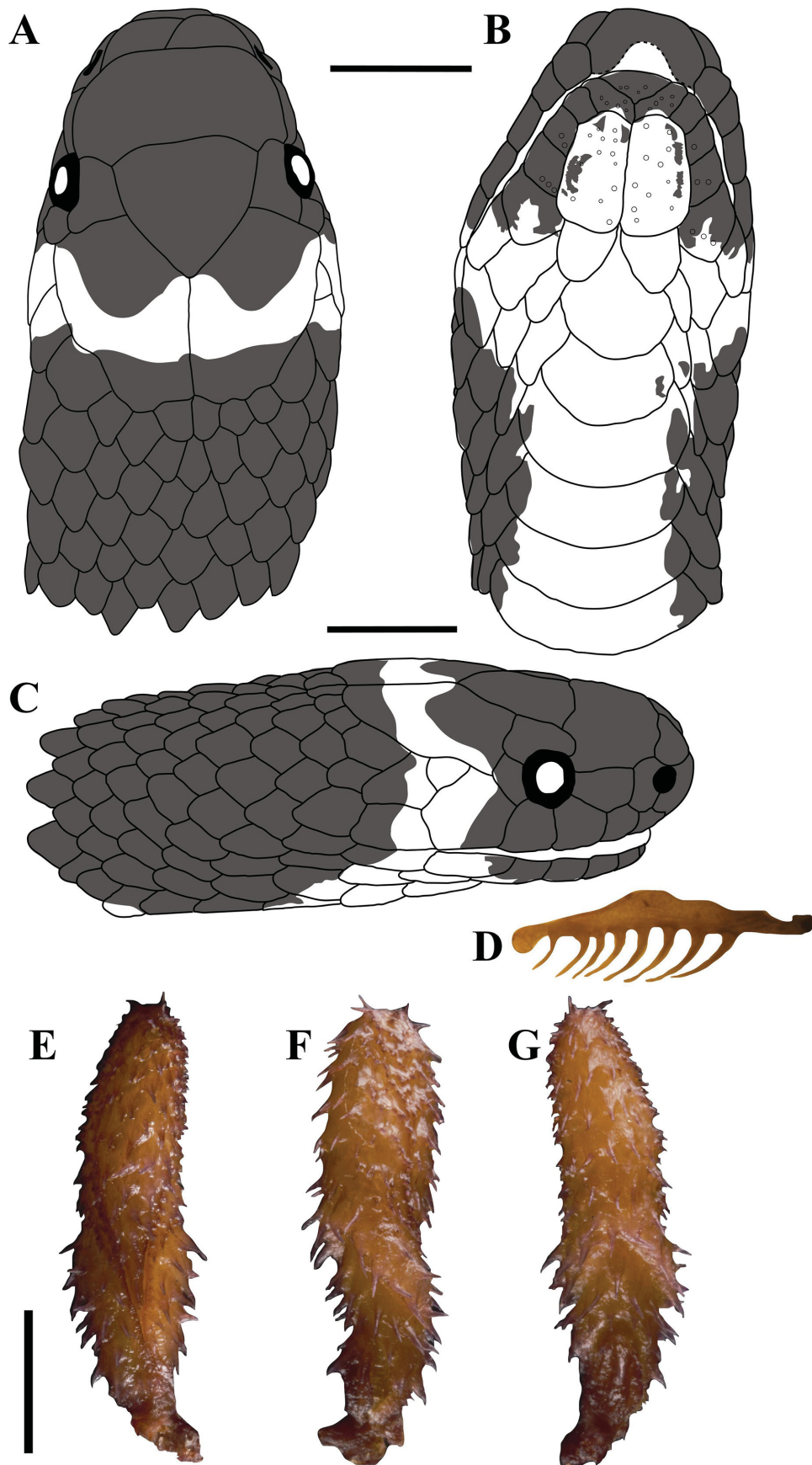
*Schmidtophis rubriventris* Taylor, 1949, Univ. Kansas Sci. Bull. 33: 169–215 [193–194]. Holotype: LSUMZ 577. Type locality: “near Xilitla (Xilitla Region), San Luis Potosí, Mexico.”

**Diagnosis.** *Chersodromus rubriventris* can be distinguished from all Mexican species of snakes by having combination of prefrontals fused into single scale; postocular discrete from supraocular; anterior temporal absent; dorsal scales keeled in 15 rows at midbody, unreduced posteriorly; supralabials usually 6, third and fourth entering orbit; infralabials 7–8, usually 1–5 contacting anterior chinshields (5 narrowly); mental not contacting anterior chinshields; venter bright red.

This species is easily differentiated from all species of *Chersodromus* by having 15 scales around body, mental scale in contact with anterior chinshields and anterior temporal absent (Table 1).

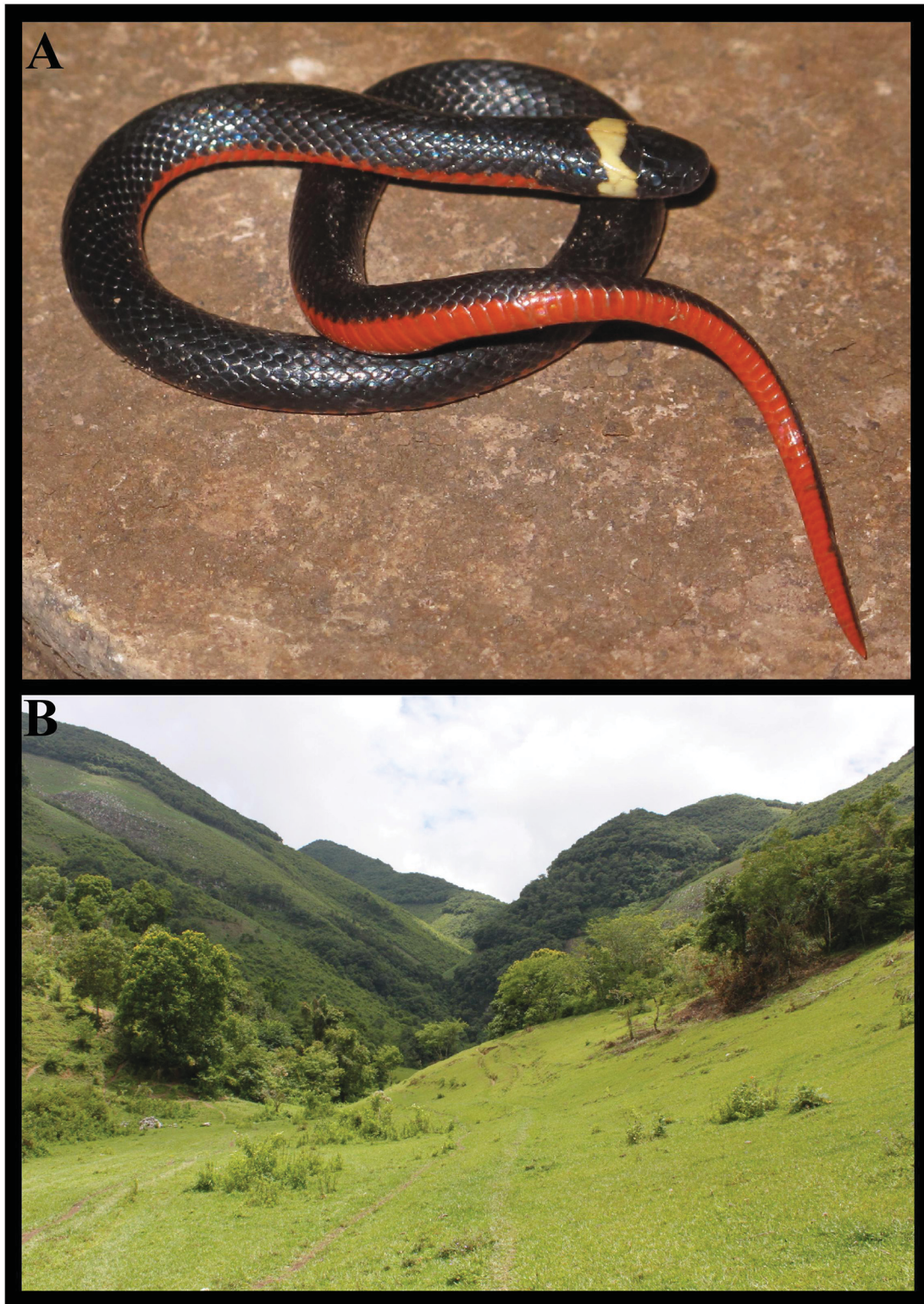
**Description.** Small, slender snake; head moderately wider than the neck. Adults reach 300–349 mm in total length, largest known male 319 mm, and the largest female 349 mm. Tail comprises 21–23% of total length in males, 17–21% in females.

Prefrontals fused into a single, large scale, supraoculars are not fused with the postoculars, frontal relatively broad, and the nasal divided. Small internasals 1/1, loreals 1/1 that extend from the postnasal to anterior edge of eye (no preoculars), discrete postoculars 1/1; temporals 0+1, supralabials 5–6 with 3–4 entering orbit, infralabials 6–7 with 1–5 contacting anterior chinshields (fifth pair narrowly and first pair in contact along midline behind mental). Mental broader than long, anterior chinshields large, pair of posterior chingshields about one-fourth to one-third size of anterior pair. Keeled dorsal scale rows 15-15-15, preventrals 2–3, ventrals 123–127 in males and 126–130 ventrals in females. Cloacal scute undivided. Divided subcaudals 41–45 in males and 37–41 in females. Dorsal scale rows at midlength of tail 6. Pupil is subcircular to vertically oval.



**FIGURE 4.** Dorsal (A), ventral (B) and lateral (C) views of the head (Scale = 3 mm); right maxilla (D, 3.09 mm); and from left to right: sulcate, lateral, and asulcate views of the hemipenis (E–G, Scale = 4.2 mm) of *Chersodromus rubriventris* (MZFC 7784).





**FIGURE 5.** Adult of *Chersodromus rubriventris* in life (CIB 4285) (A), and its habitat in a fragmented cloud forest near Chilijapa, Hidalgo (B).

A conspicuous cream, yellow, or peach collar is present on the back of head. The anterior border is irregular, usually extending on top of the head across the anterior third of the parietals and then extending forward on side of head to about the postocular. The posterior border is located slightly anterior to the posterior edge of parietals; collar usually includes about half of the parietals and portions of the posterior temporal and posterior two supralabials. Collar sometimes reduced or broken with a central blotch and bars on each side of the head. Dorsum



is blackish, narrowly extending to the lateral portion of ventrals and subcaudals. A black head cap extends from the rostral to about anterior the third of parietals, covering the internasals, a single fused prefrontal, supraoculars and fused postoculars, nasals, and loreal, and extending to the lower edge of supralabials 1–5. The mental and infralabials 1–5 (sometimes more) have a suffusion of brown pigment. Except for dark lateral edging, the belly and subcaudals are immaculate bright red.

**Maxillary dentition (Fig. 4D).** Right maxilla extending anteriorly to level of suture between second and third supralabials, dorsoventrally compressed; in lateral view, heaviest at about midlevel of bone, tapering at anterior and posterior ends; anterior one-fourth of maxillary edentate, followed by 7–9 long, slender, curved teeth, decreasing in size posteriorly.

**Hemipenis morphology (Fig. 4 E–G).** Hemipenis cylindrical, unbifurcated, semicapitate on sulcate side, uniformly ornamented by spines, sulcus spermaticus bifurcate and centrifugal, *sulcus spermaticus* bifurcation point below mid-point of hemipenis body; intra-sulcar region protruding from hemipenis body and covered with spines decreasing in size distally. In asulcate view, hemipenis uniformly ornamented with spines decreasing in size distally. Medially, inverted “V” shaped depression coinciding with bifurcation level of sulcus spermaticus (sulcate side).

**Distribution and habitat.** This species is found in the Sierra Madre Oriental in the States of San Luis Potosí, Querétaro and Hidalgo (Fig. 1). *Chersodromus rubriventris* inhabits cloud forest between 700–1650 m asl, a habitat that has been fragmented in recent years (Ramírez-Bautista *et al.* 2013, Fig. 5B).

### ***Chersodromus australis* sp. nov.**

Fig. 6, 7A Table 1

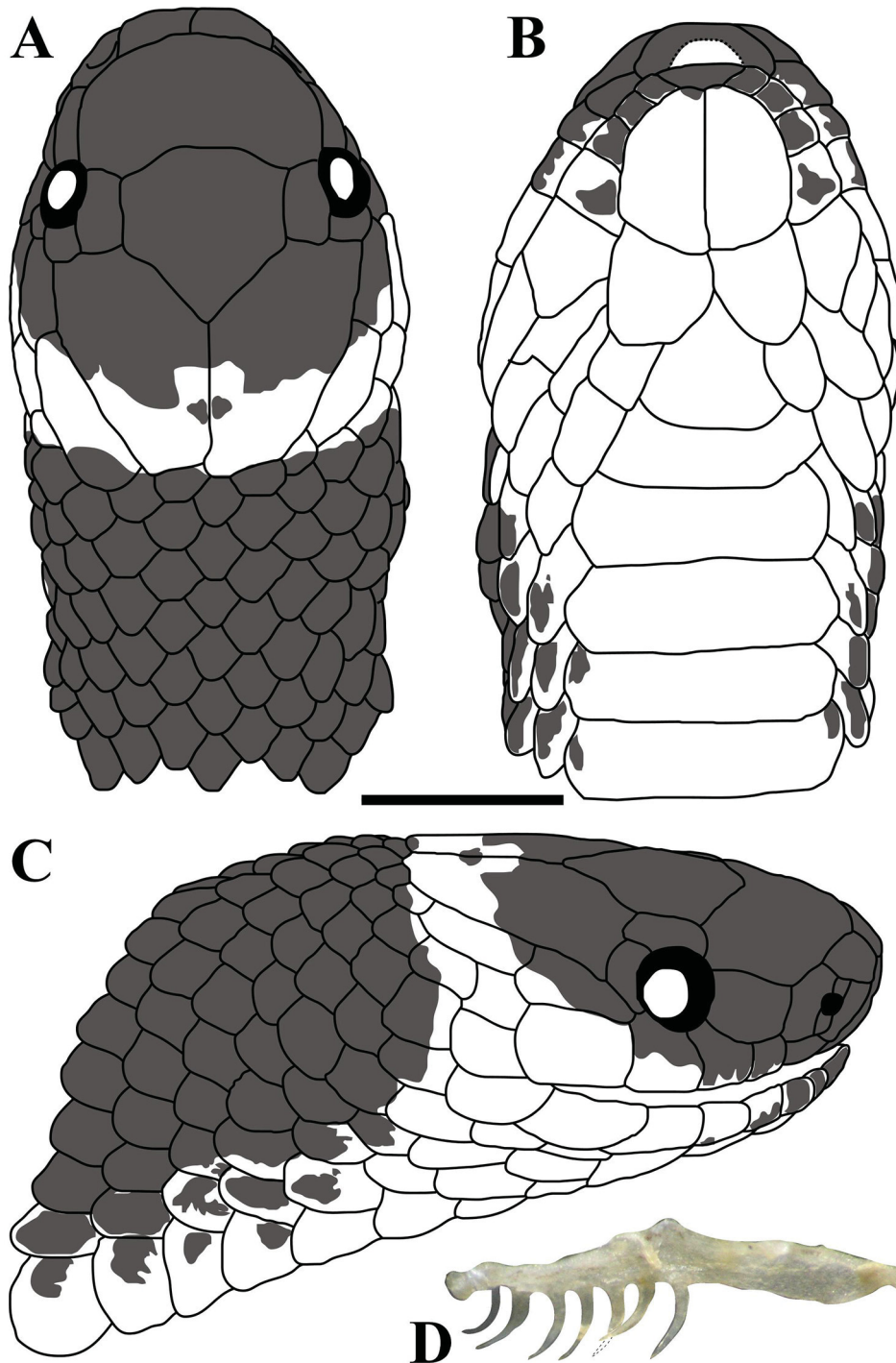
**Holotype.** An adult female, MZFC 17618 (field number EPR 388), collected by Edmundo Pérez Ramos on June 27 1995 at San Isidro La Gringa (17°04.591' N, 94°03.844' W; 350 m asl), Municipality of Santa María Chimalapa, Oaxaca, Mexico.

**Diagnosis.** *Chersodromus australis* can be distinguished from all Mexican species of snakes by having combination of prefrontals fused into single scale; postocular discrete from supraocular; single anterior temporal present; dorsal scales keeled in 17 rows at midbody, unreduced posteriorly; supralabials usually 6, third and fourth entering orbit; infralabials 7–8, usually 1–4 contacting anterior chinshields); mental contacting anterior chinshields; ventral surface of body cream colored.

*Chersodromus australis* differs of *C. rubriventris* by having 17 scales around body (vs. 15), by having eight infralabials (vs. six or seven), by having a cream colored belly (vs. orange), and by having the mental in contact with first pair of chinshields (vs. not in contact). *Chersodromus australis* differs from *C. liebmanni* by having six supralabials (vs. seven), and from the new species that follows by having a dark belly (vs. cream-colored) and in having four infralabials contacting anterior chinshields (vs. five or six) (Table 1).

**Description of the holotype.** Adult female; head length 7.3 mm; snout-vent length 180 mm; tail 40 mm; the tail comprises 22% of total length; head slightly distinct from neck; snout long, 2.6 times head length, rounded in dorsal aspect, projecting anteriorly beyond lower jaw; rostral 0.6 times broader than high, 1.9 times longer than internasal suture, with posterior end approximately at level of anterior margin of nares; internasals broader than long (length vs width on L/R sides 0.59/0.56), rounded anteriorly, in contact laterally with anterior and posterior nasals; prefrontals fused together, posterior corner contacting eye; postnasal plus loreal 0.8 times length of snout, suture between them 0.2 times frontal length; frontal longer than wide (width/length 1.1); supraocular large, in broad contact with prefrontal and parietal, contacting postocular and frontal 1.0 times as long as horizontal diameter of eye; supraocular 1.0 times as long as loreal, forming about posterior half of dorsal margin of orbit, ventral margin not projecting anteriorly beyond margin of orbit, posteriorly exceeding 0.4 times length of posterior margin of orbit; parietals 1.4 times longer than broad, approximately 0.4 times head length, parietal suture 0.8 times as long as frontal; one postocular on right side, two on left side; nasal divided; postnasal 1.0 times as long as prenasal; combined length of prenasal and postnasal 1.8 times longer than loreal length; loreal 1.1 times wider than long, 2.6 times snout length, 1.0 times longer than horizontal diameter of eye, dorsal margin straight and ventral margin concave; eye small, 2.4 times snout length, vertical diameter 0.6 times its distance from lip; supralabials six, first and second in contact with postnasal, second and third in contact with loreal, third and fourth entering

orbit, fifth largest, contacting anterior temporal; one anterior temporal in broad contact with fifth supralabial; two posterior temporals separating sixth supralabial from parietal; upper posterior temporal larger than lower; posterior temporals separated from each other by five nuchals contacting parietals; mental rounded anterior, 2.2 times broader than long, contacting anterior chinshields; infralabials eight, first four contacting anterior chinshields, fourth slightly and fifth in broad contact with posterior chinshields; anterior chinshields longer than broad (2.1/1.8), 1.5 times longer than posterior chinshields; posterior chinshields broadly contacting anterior chinshields; one preventral scale; infralabials and scales in chin region smooth; dorsals in 17-17-17 rows, keeled throughout body, without apical pits; ventrals 131; cloacal scute single; paired subcaudals 36.



**FIGURE 6.** Dorsal (A), ventral (B), and lateral (C) views of the head (Scale = 3 mm); and its left maxilla (D, 2.43 mm) of the holotype of *Chersodromus australis* **sp. nov.** (MZFC 17618).



**FIGURE 7.** Holotype of *Chersodromus australis* sp. nov. (MZFC 17618) (A), and its type-locality in Chimalapas region of Oaxaca (B).

Color (alcohol after formalin). Dorsal ground color black, including lateral borders of ventral scales; dorsum of head with a white band crossing posterior region of parietals, including all of fifth and sixth supralabials, middle of fourth, and lower part of supralabials three and four; head, first three and portion of fourth supralabial black; mental, first three and portion of fourth infralabial black; lateral edges of ventrals colored similarly to dorsum; remaining ventral surface, including throat, cream; subcaudals cream with few scattered small black spots.

**Maxillary dentition (Fig. 6D).** Left maxilla extending anteriorly to the level of suture between second and third supralabials; dorsoventrally compressed; in lateral view with dorsal flange at about midlevel, tapering at anterior and posterior ends; anterior portion of edentate, followed by seven long, slender, curved teeth; anterior five teeth subequal, posterior two slightly smaller.

**Etymology.** The specific name is derived from the Latin *australis*, meaning southern, alluding to the southernmost distribution of species for the genus.

**Distribution and habitat.** *Chersodromus australis* apparently has a relatively small distribution east of the Isthmus of Tehuantepec (Fig. 1) in the region known locally as Chimalapas; it occurs at low elevations (350 m asl) in tropical rain forest (Fig 7 B). A single specimen was obtained on June 1995 under a rock at 16:00 hrs on a mountain near San Isidro la Gringa, municipality of Santa María Chimalapa. Other amphibians and reptiles recorded at the type locality included *Incilius macrocristatus* (Firchein & Smith 1957), *Norops pygmaeus* (Álvarez



del Toro & Smith 1956), *Lepidophyma tuxtlae* Werler & Shannon 1957, *Bothrops asper* (Garman 1884), and *Tantillita lintoni* (Smith 1940).

***Chersodromus nigrum* sp. nov.**

Fig. 8, 9A–B, Table 1

**Holotype.** An adult male, MZFC 17619 (field no. ISZ 063), collected by Israel Solano Zavaleta on May 28 2005 at Xucayucan (19°53'47.9" N, 97°28'43.7" W; 1493 m asl), Municipality of Tlatlauquitepec, Puebla, Mexico.

**Paratypes.** Juvenile female, UTA R-63417 (field number UOGV 062; Fig. 9 A) collected by Uri Omar García Vázquez on February 25 2002 at 5.5 km east from Tahitic (19° 55' 33.9" N, 97° 31' 42.4" W; 1530 m asl), Municipality of Zacapoaxtla, Puebla, Mexico; and an adult female MZFC 17661 (field number ISZ 059), same provenance as the holotype, obtained dead on road on May 27 2005.

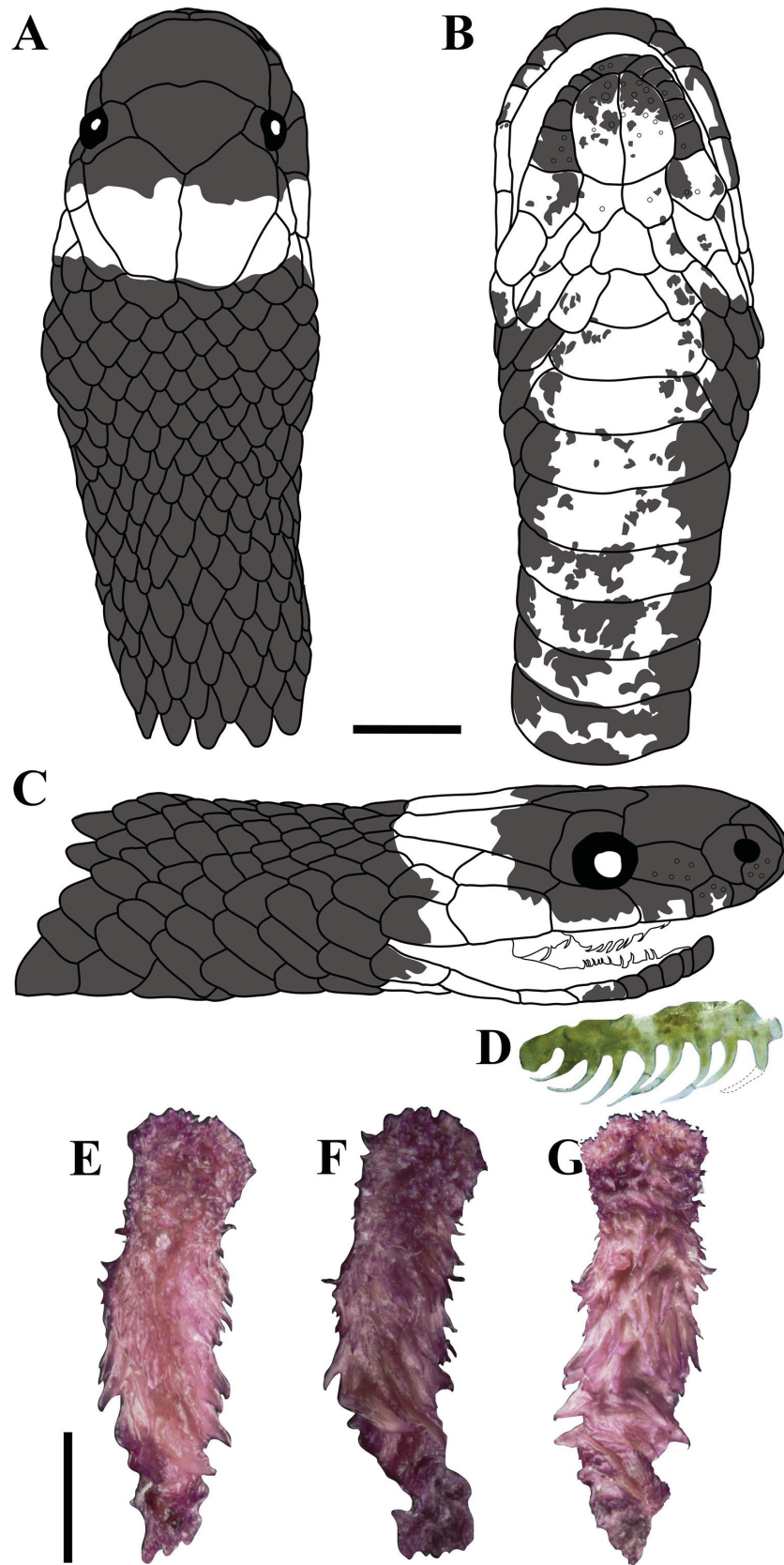
**Diagnosis.** *Chersodromus nigrum* can be distinguished from all Mexican species of snakes by having combination of prefrontals fused into single scale; postocular fused with supraocular; single anterior temporal present; dorsal scales keeled in 17 rows at midbody, unreduced posteriorly; supralabials 6, third and fourth entering orbit; infralabials 8, 1–5 contacting anterior chinshields); mental contacting anterior chinshields; venter mostly black.

This species is characterized by its large size (260–315 mm SVL). It differs from *Chersodromus rubriventris* and *C. australis* by having fused supraocular and postocular scales; distinguished from *C. australis* and usually *C. liebmanni* by having first 5 or 6 infralabials in contact with anterior chinshield (vs. 4–5), further differing from *C. liebmanni* by having six supralabials (vs. seven) (Table 1).

**Description of the holotype.** Adult male; head length 9.07 mm; snout-vent length 260 mm; tail 74 mm; the tail comprises 22% of total length in males, 18–20% in females; head slightly distinct from neck; snout long, 2.5 times head length, rounded in dorsal aspect, projecting anteriorly beyond lower jaw; rostral 0.4 times broader than high, 2.7 times longer than internasal suture, with anterior end at level of anterior margin of nares; internasals broader than long (length vs breadth on L/R sides 0.63/0.57), rounded anteriorly, in contact laterally with anterior and posterior nasals; prefrontals fused, posterior corner contacting eye; postnasal plus loreal length 0.6 times length of snout, their common suture 0.2 times frontal length; frontal wider than long (length/breadth 0.8); supraocular fused with postocular; parietals 1.6 times longer than wide, approximately 0.5 times head length, parietal suture 1.1 times as long as frontal; large postocular on each side; nasal divided; postnasal 1.0 times as long as prenasal; combined length of prenasal and postnasal 2.2 times longer than loreal length; loreal 1.5 times wider than long, 3.7/3.4 times snout length, 1.1 times longer than horizontal diameter of eye, dorsal margin convex and ventral margin straight; eye small, 2.9 times snout length; supralabials six, first and second contacting postnasal, second and third contacting loreal, third and fourth contacting orbit, the upper posterior portion of fourth contacting postocular and anterior temporal, fifth largest, contacting anterior temporal; one anterior temporal broadly contacting fifth supralabial; two posterior temporal separating sixth supralabial from parietal; upper posterior temporal larger than lower; posterior temporals separated posteriorly from each other by seven nuchals contacting parietals; mental rounded anteriorly, 2.1 times wider than long, contacting anterior chinshields; infralabials eight, first five contacting anterior chinshields, sixth in contact with posterior chinshields; anterior chinshields longer than broad (1.7/2.2), 1.9 times longer than posterior chinshields; posterior chinshields broadly contacting anterior chinshields; two preventral scales; infralabials smooth, anterior chinshield with pustules; dorsals in 17–17–17 rows, weakly keeled throughout body, without apical pits; ventrals 131; cloacal scute single; paired subcaudals 44.

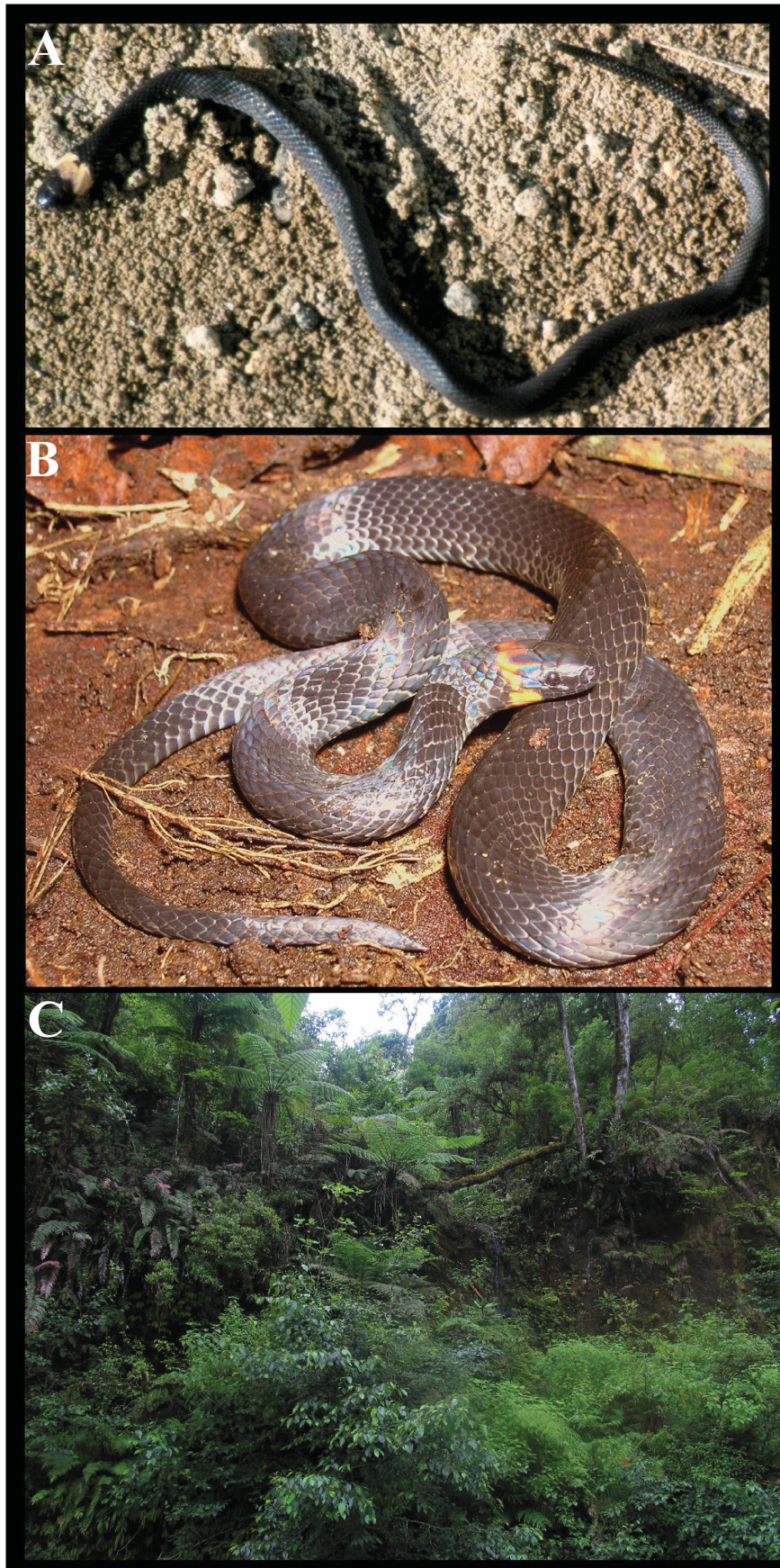
Color (alcohol after formalin). Dorsal ground color black; dorsum of head with cream band crossing posterior two-thirds of parietals, including half of the sixth supralabial and most of fifth; narrow lower portions of supralabials 2–4 cream colored or with cream spots, otherwise first four supralabials mostly black; mental and first five infralabials completely black; sixth supralabials with dark spots or mottling; chinshields and throat with irregularly scattered black spots; ventral surface mostly dark with heavy black mottling on a white background, subcaudals completely black.

**Maxillary dentition (Fig. 8D).** Right maxilla extending anteriorly to the level of suture between second and third supralabials; dorsoventrally compressed; in lateral view bone robust throughout most of length, tapering slightly posteriorly; eight long, slender, recurved maxillary teeth very slightly decreasing in size posteriorly.



**FIGURE 8.** Dorsal (A), ventral (B), and lateral (C) views of the head (Scale = 3 mm); right maxilla (D, 2.42 mm); and from left to right: sulcate, lateral, and asulcate views of the hemipenes (E–G, Scale = 2.8 mm) of the holotype of *Chersodromus nigrum* sp. nov. (MZFC 17619).





**FIGURE 9.** Juvenile paratype (A, UTA R-63417) and adult (B) specimens in life of *Chersodromus nigrum* sp. nov., and its type locality near Xucayucan, Puebla (C).



**Hemipenis morphology (Fig. 8 E–G).** Hemipenis cylindrical, slightly bilobed, covered homogeneously by spines, sulcus spermaticus centrifugal, bifurcate above mid-level of hemipenis body, walls of sulcus spermaticus robust and ornamented with spinules; intra-sulcar region covered with calyces. Two rows of hook-shaped spines present over most proximal area of hemipenis body. Basally, asulcate side with two spines resembling parallel hooks. Four rows inverted “V” shaped of spines, at level of bifurcation point of sulcus spermaticus. Distal portion of hemipenes covered by calyces with larges spines.

**Variation.** The two paratypes are females, one of which (MZFC 17661) has 315 mm SVL and 81 mm TL and is larger than the male holotype. The other female (UTA R-63417, Fig. 9A) is 102 mm SVL and 21.9 mm TL. The tail comprises 28% of SVL in the male holotype, and 21–25 % in female paratypes. There are 137 ventrals and 32 subcaudals (broken tail) in MZFC 17661, and 129 ventrals and 44 subcaudals in UTA R-63417. Both specimens have five infralabials contacting the anterior chinshield. The collar in life varies from pale cream to yellowish (Fig. 9A–B).

**TABLE 1.** Select quatitative and qualitative features increased by habitat/distribution data from the four currently recognized species of *Chersodromus*.

|   | <i>C. australis</i> (N=1)                 | <i>C. liebmanni</i> (N=54)                   | <i>C. nigrum</i> (N=3)          | <i>C. rubriventris</i> (N=6)                                    |
|---|---|--|---------------------------------|---|
| SVL (mm)                                    | 180                                       | 273  | 315                             | 259   |
| TL (mm)                                     | 39  | 69   | 81                              | 71  |
| Ventrals                                    |   |  |                                 |   |
| Male  | —   | 121–136                                      | 131                             | 123–127   |
| Female                                      | 131                                       | 126–140                                      | 129–137                         | 126–130   |
| Subcaudals                                  |   |  |                                 |   |
| Male  | —   | 32–42  | 44                              | 41–45   |
| Female                                      | 36  | 31–39  | 44                              | 37–41   |
| Supralabials                                | 6   | 7  | 6                               | 6   |
| Infralabials                                | 8-8                                       | 7-8  | 8                               | 6-7   |
| Postocular                                  | 1   | Fused with supraocular                       | Fused with supraocular          | 1   |
| Supraoculars                                | 1   | Absent                                       | Absent                          | 1   |
| Anterior temporal                           | Present                                   | Present                                      | Present                         | Absent  |
| Mental /anterior chinshield                 | In contact                                | In contact                                   | In contact                      | Separate  |
| Preventrals                                 | 1   | 2  | 2                               | 2-3   |
| Scales around body                          | 17-17-17                                  | 17-17-17                                     | 17-17-17                        | 15-15-15  |
| Ventral coloration                          | Cream                                     | Cream  | Mostly black                    | Bright red  |
| Infralabials contacting anterior chinshield | 4   | 4-5  | 5- 6                            | 5   |
| Maxillary teeth                             | 8   | 7  | 7                               | 7-9   |
| Habitat                                     | Tropical rain forest                      | Cloud forest and disturbed areas             | Cloud forest and pine forest    | Cloud forest and disturbed areas                                |
| Elevation                                   | 350                                       | 1000–1878                                    | 1493–1530                       | 700–1650  |
| Distribution                                | Eastern of Isthmus of Tehuantepec, Oaxaca | Central Veracruz, Puebla and northern Oaxaca | Sierra Madre Oriental of Puebla | Sierra Madre Oriental of San Luis Potosí, Querétaro and Hidalgo |

**Etymology.** The specific name is from Latin *nigrum*, meaning black, alluding at to the coloration of the dorsal and ventral surface.

**Distribution and habitat.** This species is occurs in the cloud forests of the Sierra Madre Oriental of northern Puebla (Fig. 1 and 9 C) at elevations between 1493–1560 m asl. Other species of amphibians and reptiles recorded

in the area include, *Chiropterotriton* sp., *Charadrahyla taeniopus* (Günther 1901), *Craugastor rhodopis* (Cope 1867), *Rheohyla miotypanum* (Cope 1862), *Diploglossus legnotus* Campbell & Camarillo 1994, *Scincella silvicola* (Taylor 1937) and *Geophis* sp.

### Key to the species of the genus *Chersodromus*

1. Scale rows around body 15; first pair of infralabials in contact along ventral midline; anterior temporal absent; venter bright red ..... *C. rubriventris*
2. Scale rows around body 17; first pair of infralabials not in contact along ventral midline; anterior temporal present; venter cream or dark. .... 3
3. Venter mostly black ..... *C. nigrum*  
Venter uniformly cream. .... 4
4. Supralabials seven; fifth supralabial small, situated beneath postocular ..... *C. liebmanni*  
Supralabials six; fifth supralabial large, situated below primary temporal. .... *C. australis*

### Discussion

The two new species described here come from poorly explored regions of Mexico. *Chersodromus nigrum* is known only from northern Puebla. The first specimen encountered was a juvenile from near Tahitic, Zacapoaxtla in 2002. Subsequently, two adults were found dead in 2005 near Xucayucan, Tlatlauquitepec. Finally, an adult male, was taken and released from Rancho Dos Ríos, Hueyapan in 2010. This region on northern Puebla does not encompass a large area but apparently harbors a large number of endemic species. Even this area has yet to be thoroughly surveyed biotically, a number of species have been described (Canseco-Márquez *et al.* 2002; Parra-Olea *et al.* 2004) and other new species are currently in the process of being described (e.g. salamanders of the genus *Chiropterotriton* and *Aquiloerycea* and the snake genus *Geophis*).

To the south, one of the most surprising finds is *Chersodromus australis*, known from only one female specimen. The distribution of this species is enigmatic, because it is isolated with respect to other species, occurring east of the Isthmus of Tehuantepec. It is the only member of the genus inhabiting tropical rain forest at low elevations. All other species are denizens of the cool, upland cloud forests at moderate elevations. This species comes from the southeastern-most segment of Oaxaca in the Chimalapas, a remote and unexplored region. This region contains the most extensive extant of tropical rain forest in Mexico and is considered an important site for conservation because of its great biodiversity, which remains poorly understood. The naturalist and botanist Thomas McDougall made some of the first herpetological explorations of this region, but information published on the amphibians and reptiles remains scarce. The Chimalapas encompasses many types of habitats such as tropical rain forest, tropical dry forest, cloud forest, montane pine and pine-oak forest (Peterson *et al.* 2003), and the only information available about the number of amphibians and reptiles from this region is given by Navarro-Sigüenza *et al.* (2008) and Aguilar-López *et al.* (2016). Further information on the distribution of certain species is provided by Canseco-Márquez and Ramírez-González (2015), and a new species of *Ptychohyla* is known from the region (Canseco-Márquez *et al.* 2017). Our current knowledge strongly indicates that the biological importance of the region is exceptionally high and further studies into its biota will be rewarding.

With the discovery of two species, the genus *Chersodromus* now contains four species. None of these can be regarded as common, but *Chersodromus liebmanni* is the more frequently encountered species, probably because of its broader distribution and existence at more localities where herpetological collections have been made. *Chersodromus rubriventris* is rarely encountered for reasons that are not currently well understood. The species was known until recently from only three specimens, one from the type locality in Xilitla, San Luis Potosí and two from Querétaro. Subsequently, Ramírez-Bautista *et al.* (2013) rediscovered the species, providing a new locality in Hidalgo and information about morphological variation.

Certain features distinguished the currently recognized congeners (Table 1). *Chersodromus rubriventris* is perhaps the most distinct species in the genus with no anterior temporal, 15 dorsal scales around body, mental scale separated from anterior chinshields by the first pair of infralabials that are in contact medially, and the bright red venter coloration. *Chersodromus liebmanni* and *C. nigrum* have supraoculars and postoculars fused forming a single plate. Generally *C. liebmanni* has seven supralabials (vs six in all other species). *Chersodromus nigrum* is



the largest species, reaching a maximum of 315 mm SVL in females, and the high number of subcaudals (44) usually distinguishes it from other species except for *C. rubriventris*. Additionally *C. nigrum* is the only species with the dark venter. *Chersodromus australis* is most easily distinguished by a combination of features and is unique in having only a single preventral.

*Chersodromus rubriventris* is categorized by the IUCN as endangered (En) (Lavin & Mendoza-Quijano 2007), and *C. liebmanni* is catalogued as of least concern (LC) because no threats have been identified (Canseco-Márquez *et al.* 2007). Both species are considered as species for special protection (SEMARNAT 2010).

The cloud forest habitat of *Chersodromus* along the Atlantic Versant of Mexico west of the Isthmus of Tehuantepec has been highly disturbed owing to human activities and mostly only small patches remain. This ecosystem is among the most threatened in Mexico (Ornelas *et al.* 2013). To the east of the Isthmus, *C. australis* inhabits tropical rain forest, which has more broader and continuous distribution in the southern part of Mexico. Nevertheless it also is under serious threats, some that include antropogenic activities of agriculture and cattle raising, which are leading to vast areas of habitat loss.

The Chimalapas region has been regarded as one of the priority areas for conservation, and possesses one of the most extensive intact tropical rain forests in Mexico (Salas-Morales *et al.* 2001). Effective local conservation strategies and policies hopefully will be implemented in the near future for the Chimalapas and a series of “island” cloud forests along the major windward mountain escarpments of Mexico. This would help ensure the continued existence not only of the little snakes of the genus *Chersodromus*, but also protect the overall remarkable biodiversity of these forests.

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## APPENDIX I

### Specimens examined

***Chersodromus liebmanni*.** OAXACA: UTA R-12253–55, 14132: Sierra Mixe: 0.8 km W Totontepec, 1878 m; MZFC 28687: Sierra Mixe: Totontepec; MZFC 6842: Peña Verde; RVG 412 (uncatalogued): Sierra Mazateca: 0.9 km W Río Seco, Mpo. Santa María Chilchotla. PUEBLA: ITSZ R-005: San Miguel Eloxochitlán. VERACRUZ: ITSZ R-006, 030, 046: Zongolica; UTA R-52625: Ixhuatlán del Café, Guxmantla; Zongolica; Cautlapan: FMNH 105101-05, 111976–86: Cautlapan; Mts immediately SE Cautlapan, 3500–3800 ft: FMNH 70688; USNM 7102: Orizaba, USNM 109917–18: Cautlapan, USNM 109925, 109927–29, 109931, 109933–34, 224828, 30407: Cautlapan, MCZ 45691: Metlac, MCZ 162830: Matzinga, nr Estacion Piscicola nr Orizaba; CAS 87840: Cautlapan; CAS 135694: Barranca, 2 km N Teocelo; MVZ 144247–48: 1.2 mi N (by road) Teocelo town square, 1122 m, MVZ 171537: Barranca de Teocelo, 1070 m, MVZ 76350: 5 mi E Orizaba, Cautlapan; AMNH 75978–79: Cautlapan; TCWC 12798: Cautlapan.

***Chersodromus rubriventris*.** QUERÉTARO: TCWC 57131: 11.4 mi E La Lagunita, Hwy 120; TCWC 28919: 2.4 mi W El Madroño. SAN LUIS POTOSÍ: MZFC 7784: El Raizal; HIDALGO: CIB 4285-87: Chilijapa.