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A NEW MONTANE RATTLESNAKE (VIPERIDAE) FROM MICHOACAN, MEXICO

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ABSTRACT: A new species of rattlesnake is described from the upper elevations of Cerro Tancítaro in Michoacán, in the western portion of the Transverse Volcanic Cordillera. This diminutive rattlesnake appears to be most closely related to several species also occurring at high elevations in Mexico and the southwestern United States including *Crotalus intermedius*, *C. pricei*, and *C. transversus*. The Tancítaro species is most similar to *C. transversus*, but differs in aspects of lepidosis and color pattern.

Key words: Cerro Tancítaro; *Crotalus tancitarensis*; Mexico; Michoacán; New species; Reptilia; Serpentes; Squamata; Viperidae

THE MEXICAN Plateau and associated highlands have long been recognized for their richness of rattlesnake species, and this region has been suggested as the "center of origin" for this group of snakes (Gloyd, 1940). This region harbors the greatest number of species of small montane rattlesnakes, which have presented challenges to several generations of taxonomists.

Confusion regarding these montane rattlesnakes was augmented by various authors, but most notably Amaral (1927) and Boulenger (1896), who had difficulty distinguishing them and synonomized such distinct species as *Crotalus triseriatus*, *C. intermedius*, and *C. pricei* into a single species. All individuals in a series of rattlesnakes from Cerro Tancítaro, consisting of three species (*C. triseriatus*, *C. pusillus*, and the species described herein), were allocated to *C. triseriatus* by Schmidt and Shannon (1947). Klauber (1952) recognized the composite nature of this series—he distinguished and described *C. pusillus*, recognized *C. triseriatus* as comprising part of the series, and identified one individual as *C. intermedius*. Subsequently, this single specimen from Cerro Tancítaro was referred to as *C. intermedius* by a number of authors (Armstrong and Murphy, 1979; Duellman, 1961; Harris and Simmons, 1978; Klauber, 1972). Campbell (1982) questioned the allocation of the Tancítaro specimen to *C. intermedius* and suggested it was more closely allied to *C. transversus* or perhaps represented a novel species.

MATERIALS AND METHODS

Scale definitions and protocols for making scale counts follow Klauber (1972) and Campbell and Lamar (2004). Measurements of body and tail were taken to the nearest 1 mm using a meter stick; those of the head, fang, and rattle were made to the nearest 0.1 mm using vernier calipers. Geographic coordinates were obtained using a handheld GPS receiver; geographic names and distances are based on topographic maps (1: 1,000,000) issued by the Dirección General de Geografía, Mexico. Specimens were fixed in buffered formalin (diluted to 10% of stock solution) and then transferred within 1 wk into 70% ethanol for permanent storage. Notes of color in life were taken from photographs of live specimens and notes taken from observation.

This new little rattlesnake, insofar as is known, is restricted to the upper elevations of the impressive volcano known as Cerro Tancítaro. It may be known as:

Crotalus **tancitarensis** *sp. nov.*

Crotalus triseriatus triseriatus—Schmidt and Shannon, 1947, Fieldiana Zoology 31(9): 84 [Not of Wagler, 1830]

Crotalus intermedius intermedius—Klauber, 1952, Bulletin of the Zoological Society of San Diego 26: 9 [Not of Troschel *in* Müller, 1865]

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Crotalus species inquirenda, Campbell, 1982, Southwestern Naturalist 27(3): 353

Holotype.—Herpetología, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana de San Nicolás de Hidalgo, Michoacán (INIRENA) 309, an adult female from Cerro Tancítaro, Michoacán, Mexico, 3225 m elevation (coordinates 19° 24′ 13″ N, 102° 19′ 45″ W), collected on 17 July 2002 by Javier Alvarado-Díaz and Alfredo Estrada Virgen (Fig. 1A).

Paratypes.—The University of Texas at Arlington (UTA) R-52401 [formerly INIRENA 308], an adult female collected at same locality on the same date by the same collectors as the holotype (Fig. 1B); Field Museum of Natural History (FMNH) 39115, an adult female from Cerro Tancítaro, reportedly from 1524 m, collected between 25 June and 20 July 1941, by F. A. Shannon.

Diagnosis.—*Crotalus tancitarensis* may be distinguished from all other species of rattlesnakes by the combination of 21 dorsal scale rows at midbody, a dorsal pattern of 49–51 narrow crossbands, and a loreal that is longer than high and in contact with the supralabial series (Fig. 2). *Crotalus tancitarensis* is a diminutive montane rattlesnake in the *C. intermedius* group, which includes *C. intermedius*, *C. pricei*, and *C. transversus* (Table 1). Species in this group are defined by having a small, narrow head and 21 dorsal scale rows at midbody. *Crotalus intermedius* differs from *C. tancitarensis* in usually having paired nape markings, middorsal blotches rather than crossbands, usually four scales across the prefrontal region, and a loreal that is as high or higher than long. *Crotalus pricei* may be distinguished by the shape (or absence) of the nape blotches, paravertebral blotches that are separated or narrowly fused across the dorsum, usually four scales across the prefrontal region, and a loreal that is usually in contact with the lower preocular but does not contact the supralabial series. *Crotalus transversus* differs from *C. tancitarensis* in having paired parentheses-shaped or parallel blotches or bars on the nape, 37–43 (versus 49–51) dorsal crossbands on the body, a loreal that is as high or higher than long and that usually does not contact the supralabial series, a lower preocular that is narrowly tapered anteriorly but usually reaches the loreal, and 136–155 ventrals in females (versus 158–160).

Individuals of several other species of montane rattlesnakes in Mexico may have 21 dorsal scale rows at midbody, although this is not the modal number for most populations. *Crotalus aquilus*, *C. lepidus*, *C. ravus*, and *C. triseriatus* all have fewer than 45 primary dorsal markings on the body and usually more than 10 supralabials. *Crotalus aquilus*, *C. ravus*, and *C. triseriatus* are further distinguished from *C. tancitarensis* by having 156 or fewer ventrals and body markings in the form of distinct middorsal blotches. The dorsal body pattern of *C. lepidus* is usually of dark crossbands, but these are more than a single dorsal scale long. Further the upper preocular in *C. lepidus* is vertically divided.

Description of holotype.—The rostral is about 1.5 times wider than high. There are two large, platelike internasals that are in contact with the rostral; three prefrontals are present (lateral scales may be considered canthals), with two large scales laterally and a smaller scale medially, and two intersupraoculars. A single loreal is present on each side and intervenes to preclude postnasal–upper preocular contact. The loreal is broadly separated from the lower preocular, but does contact the first and second supralabials. A prelacunal is inserted partially between the loreal and second supralabial, preventing broad contact of these scales. No prefoveals are present. The prenasal and postnasal are in contact with the first supralabial. The upper preocular is not vertically divided. The anterior subocular contacts supralabials 3–4. No interoculabials are present, and the subocular scales are in contact with the supralabial series. There are 9/9 supralabials, 9/9 infralabials, 21 dorsal scale rows at midbody, 158 ventrals (exclusive of preventrals), 21 subcaudals (proximal 11 undivided, distal 10 divided), and 8 rattle-fringe scales.

Measurements of holotype.—The holotype (INIRENA 309) is an adult female, 35.6 cm in total length (TL), with a tail length of 2.9 cm (8.1% of total). The head length is 17.5 mm and the width of the proximal segment (sensu Klauber, 1972) is 3.5 mm. There are 11 rattle segments that appear to represent the complete rattle.

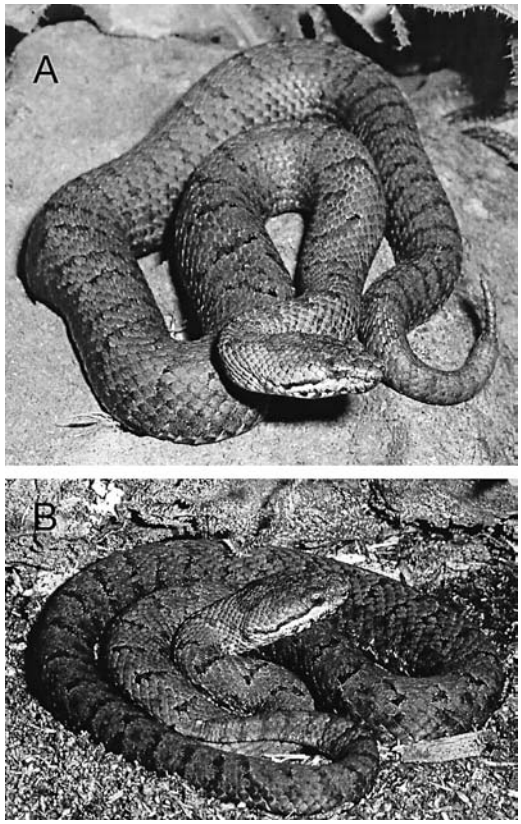

FIG. 1.—*Crotalus tancitarensis*. (A) Holotype, INIRENA 308, 35.6 cm total length; and (B) Paratype, UTA R-52401, 39.7 cm total length.

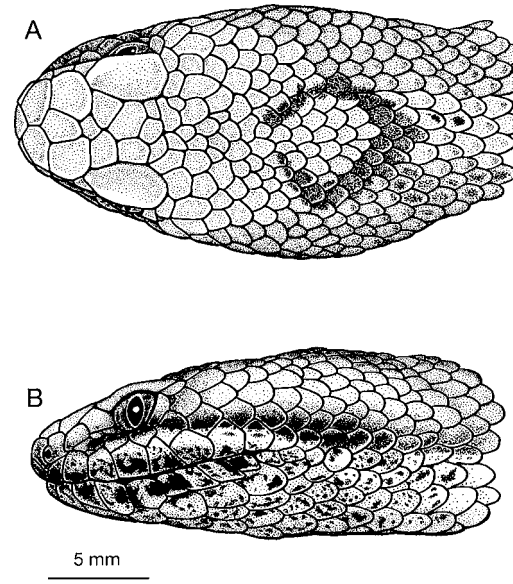

FIG. 2.—(A) Dorsal and (B) lateral aspects of the head of *Crotalus tancitarensis* (UTA R-52401, paratype), showing details of scalation.

Coloration of holotype.—The dorsal ground color in life was pale blue-gray. A black omega-shaped nape mark is present and a black postocular stripe extends from the lower posterior edge of the eye to the angle of the jaw. The supralabials were cream with black mottling. The body has 51 dark crossbands, which are one scale long with irregular edges and not bordered by any color other than the background color. At midbody, crossbands extend to about the third scale row. There are 11 crossbands on the tail; the tail bands on the distal portion of the tail are not complete and are broken along the vertebral line. An irregular stripe, pinkish copper in life and 1 to 3 scales wide on the anterior of the body, extends along the middorsum and is interrupted by the crossbands. The mental is black and the infralabials are cream with black mottling. The throat is also cream. The anterior half of each ventral scale is cream with a dark gray suffusion; posteriorly each ventral was copper-colored. The proximal subcaudals are colored similarly to the ventrals, but became orangish on the distal third of the tail. The basal segment of the rattle was orange.

Variation.—The paratypes (when two figures are given, UTA R-52401 followed by FMNH 39115) are females 39.7 and 41.0 cm in TL, with tail lengths of 3.0 and 2.6 cm (7.6 and 6.3% of total). The head length is 18.2 and 19.2 mm and the fang measures 2.0 and 1.7 mm from the upper lumen to the tip. The proximal rattle segment is 3.7 and 4.0 mm wide. There are two rattle segments in UTA R-52401. The anal glands extend posteriorly for about six subcaudals.

Three or four internasals are present (UTA and FMNH, respectively), and the scales on top of the head are smooth with weak keeling beginning posterior to the parietal region. A small prefoveal is present on the right side in FMNH 39115. The loreal contacts supralabials 1–2 on both sides in UTA R-52401, and, in FMNH 39115, it contacts supralabials 1–2 on the left side and only supralabial 1 on the right side. On the anterior portion of the body, the lower three scale rows are smooth; at

TABLE 1.—Selected characteristics of lepidosis and pattern for members of the *Crotalus intermedius* group. Where two ranges of figures are given, males are above females.

Characters	*C. intermedius*	*C. pricei*	*C. trancitarensis*	*C. transversus*
Nape marking	Paired parentheses-shaped or parallel bars, rarely fused anteriorly	Variable; usually paired bars that may be fused posteriorly; nape markings often absent	Inverted omega or incomplete circle	Paired parentheses shaped or parallel blotches or bars
Dorsal body pattern (exclusive of tail)	38–61 small dorsal blotches	Most frequently 39–64 small paravertebral blotches; sometimes fused medially	49–51 dorsal crossbands	37–43 dorsal crossbands
Scales across prefrontal region (including canthals)	Usually 4	Usually 4	Usually 3	Usually 3
Shape of loreal	As high or higher than long	Longer than high	Longer than high	As high or higher than long
Loreal–lower preocular contact	Yes, or narrowly separated	Yes	No	Usually, lower preocular narrowly tapered anteriorly
Loreal contact with supralabial series	Often in contact with supralabials 1–2 but sometimes separated by prefoveal	No	Yes	Usually no
Ventrals	151–175 157–185	137–162 143–171	158–160	141–145 136–155
Subcaudals	21–29 18–24	21–33 18–27	21–22	25–26 19–22

midbody only the lower two scale rows are smooth, and this number is reduced to a single row posteriorly. There are 9 supralabials (8 on one side of FMNH 39115), 9 infralabials (10 on one side in FMNH), 21 midbody dorsal scale rows, 159–160 ventrals, and 21–22 subcaudals (distal 5 divided in UTA R-52401).

The overall coloration of a paratype (UTA R-52401) in life was similar to that of the holotype. There are 49 dark crossbands on the body, which extend at midbody to dorsal scale row 3–7 (usually to rows 6 or 7, but to 3 where fused with small lateral blotches). The tail is marked with 10 dorsal crossbands, all of which are uninterrupted.

Habitat.—Cerro Tancítaro reaches an elevation of 3842 m. Goldman (1951) collected in the region during 1903 (February 23–March 3) at elevations of 9000–12,000 feet (2743–3658 m) and observed the snow line as low as about 11,000 feet (3353 m). However, he was told by local inhabitants that the snow sometimes occurred as low as 2134 m.

The type-locality of *C. tancitarensis* is dominated by a pine-fir forest. Other trees in the area include willows and a narrow-leaved species of oak (Goldman, 1951). The holotype and one of the paratypes were found on an exposed, southeast-facing talus slope that was covered with a patch (60 × 25 m) of bunchgrass intermingled with rocks and boulders. The snakes were collected at approximately the same elevation (3225 m) only about 50 m and 15 min apart. The paratype was found under a rock at 1400 h, and the holotype was encountered lying exposed on the ground at 1415 h. Rain had fallen a short time previously, and cloudy conditions prevailed with dappled sunlight filering through the clouds. The air temperature was 14 C.

Crotalus triseriatus has been found at similar elevations to *C. tancitarensis* on Cerro Tancítaro, and apparently these two species are sympatric. Another montane species, *Crotalus pusillus*, occurs somewhat lower on the mountain at elevations of 1525–2380 m

(Campbell and Lamar, 2004). *Crotalus pusillus* is similar in appearance to *C. triseriatus*, and a series of snakes from Cerro Tancítaro containing both of these species and one individual of *C. tancitarensis* were all reported under *C. triseriatus* (Schmidt and Shannon, 1947).

The elevation from where one of the paratypes (FMNH 39115) purportedly was collected appears to be unusually low (1524 m) in comparison with the provenance of other individuals of this group, which rarely descend to 2000 m. We suspect that the elevational data for this specimen pertains to the elevation for the base camp or the primary collecting locality of the field party.

Etymology.—The specific epithet is derived from the name of the type locality, Tancítaro and the Latin suffix *-ensis*, denoting place. The name Tancítaro is taken from the Tarascan language and means "place of offering."

Discussion.—*Crotalus tancitarensis* shares similarities with several other montane species of rattlesnakes, most notably *C. intermedius*, *C. pricei*, and *C. transversus*. It is most similar to *C. transversus* in color pattern. *Crotalus transversus* is known from several localities in the highlands to the south and west of Mexico City (Fig. 3; Camarillo and Campbell, 1993, 2002; Campbell, 1988; Taylor, 1944). These localities are separated from the type-locality of *C. tancitarensis* by over 300 km of mostly unfavorable habitat, although small, isolated patches of high montane forest occur on several of the higher volcanoes of the western portion of the Transverse Volcanic Cordillera, including Nevado de Toluca (4690 m, México), Cerro de San Andrés (3500 m, Michoacán), and Nevado de Colima (4240 m, Jalisco). It is possible that yet undiscovered populations of rattlesnakes occur on these intervening highlands.

On the basis of morphology, size and proportions, and elevational and geographical distribution, Gloyd (1940) implied a close relationship among certain montane species when he proposed recognition of the *C. triseriatus* group, which was composed of two species: *C. triseriatus* containing five subspecies (*triseriatus*, *pricei*, *omiltemanus*, *anahuacus*, and *miquihuanus*) and *C. lepidus* containing two subspecies (*lepidus* and *klauberi*).

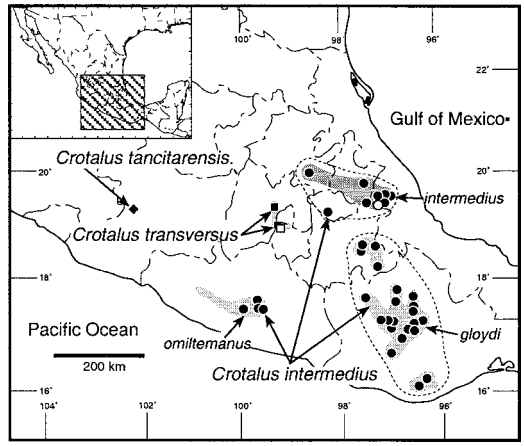

FIG. 3.—Map of central and southern Mexico showing Transverse Volcanic Cordillera and associated highlands, type-locality for *Crotalus tancitarensis* (diamond) and localities from where *C. transversus* (squares) and *C. intermedius* (dots) have been found (squares). Shaded areas represent probable distributions.

Klauber (1952) listed four squamational characters that characterized the *C. intermedius* group, but none of these are consistent among species: (1) prenasal and loreal frequently in contact over the top of a much reduced postnasal. *Crotalus tancitarensis* differs in having a large postnasal that broadly separates the prenasal and loreal. (2) loreal contacting one or more supralabials in *C. intermedius*, but not in *C. transversus*. In *C. tancitarensis*, the loreal contacts at least the first supralabial. (3) lack of prefoveals. *Crotalus tancitarensis* possesses a large prelacunal, but no prefoveals. (4) lower preocular extending to pit, but failing to contact the loreal. In *C. tancitarensis*, the lower preocular extends to only the upper posterior border of the pit.

Smith (1946) was the first to advance a cogent argument for the separation and recognition of several groups of small, montane rattlesnakes. The *C. intermedius* group, as recognized at least in part by Smith (1946) and Klauber (1952, 1972), is characterized by a dorsal row scale formula of 21-21-17, a low number of labials (8–10), a relatively small head, weak or no keeling in the parietal region, and simple arrangement of relatively few scales on the side of the head.

A close relationship among *C. intermedius*, *C. pricei*, and *C. transversus* has been suggested on the basis of morphological phenetics

(Klauber, 1972) and molecular cladistics (Murphy et al., 2002). Klauber (1972) suggested that *C. aquilus*, *C. pusillus*, and *C. triseriatus* were contained within the *C. intermedius* group, whereas Murphy et al. (2002) excluded those species from the *C. intermedius* group, and indicated that *C. willardi* was the sister-taxon to the *C. intermedius* group.

Members of the *C. triseriatus* group (containing *C. triseriatus*, *C. aquilus*, and *C. lepidus*) may be distinguished from the *C. intermedius* group most easily by the presence of prefoveals, usually 23 or more rows of dorsal scales at midbody, a relatively larger, broader head, and a stouter body (Dorcas, 1992; Klauber, 1952; Smith, 1946).

Resumen

Una nueva especie de serpiente de cascabel se describe de las altas elevaciones del Cerro Tancítaro en Michoacán, en la porción Oeste de la Cordillera Volcánica Transversal. Esta cascabel diminuta aparenta estar cercanamente relacionada a varias especies que también ocurren a altas elevaciones en México y en el Suroeste de los Estados Unidos, *Crotalus intermedius*, *C. pricei* y *C. transversus*. La especie de Tancítaro es mas similar a *C. transversus*, pero difiere en aspectos de lepidósis y patrón de color.

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