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Natural History Notes on *Crotalus tancitarensis* (Serpentes: Viperidae)

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The Tancítaro Cross-banded Mountain Rattlesnake, *Crotalus tancitarensis*, is only known to inhabit the upper elevations of the volcano known as Cerro Tancítaro in Michoacán, México. The species was recently described from three specimens by Alvarado-Díaz and Campbell (2004), who placed it in the *Crotalus intermedius* species group of Mexican montane rattlesnakes, which also includes *C. intermedius*, *C. pricei*, and *C. transversus* (Murphy et al. 2002). This report provides information on nine additional individuals of *C. tancitarensis* with respect to variation in scalation and color pattern, and also on parturition dates, litter size, neonate characters, and food acceptance in captivity.

Methods

All snakes were collected approximately 800 m N of the type locality at Los Portales, Michoacán, México, at 3220 m elevation (coordinates 19°24'13"N, 102°19'45"W) on Cerro Tancítaro. The site is a steep, south-facing slope about 70 × 250 m, covered by grass, herbs, and rocks. The site is bordered to the north by a 3 m high rock wall, to the south by a deep cliff and to the east and west by pine-fir forest, which is the dominant plant formation in the area. Cerro Tancítaro (max. elev. 3900 m) is located in the western portion of the Transverse Volcanic Cordillera. Above 3000 m, the mean annual temperature ranges from 5–12°C, with an average annual rainfall of 1500 mm. Most rain falls from June to October after a 5–6 month dry season (García et al. 2002).

One adult female and two juvenile females were collected on 19 July 2003 between 1400 and 1530 h when the air temperature was 23°C. Another adult female was caught on 29 October 2005 at 1345 h when the air temperature was 19°C. Palpation indicated that the second female was gravid, so it was held in the laboratory until after giving birth to four live and one stillborn neonates on 21 March 2006. All individuals eventually either died or were euthanized and were later deposited in the herpetological collection, Instituto de Investigaciones sobre los Recursos Naturales, Universidad Michoacana de San Nicolás de Hidalgo (INIRENA).

The non-gravid adult female collected in July 2003 (INIRENA 421) was active and the juveniles (INIRENA 414, 423) were coiled under stones. The juveniles were euthanized and preserved immediately after capture. The female was maintained live in a glass vivarium (L50 × W26 × H30 cm) in a laboratory building located at an elevation of 2000 m until she died on 23 November 2006. Ambient temperatures were maintained between 16 and 24°C (mean = 21°C) and laboratory windows provided a natural photoperiod. Room temperature readings were taken every day with a mercury thermometer to the nearest 1°C at 1000 and 1600 h. Basking spots were provided from 1100 to 1500 h, at temperatures between 27 and 30°C, using 50 W incandescent spot-light bulbs. Food acceptance was evaluated by presenting various kinds and life stages of live invertebrates and vertebrates to the adult female INIRENA 421. If food items were not consumed, after 2 h in the case of vertebrates and 24 h for invertebrates, the items were removed from the cage.

The gravid female (INIRENA 560) was found inactive under a stone. The snake was maintained live for five months under the same conditions as described above, until parturition. Of the five neonates (INIRENA 570–575, 3 females and 2 males), the four live ones were maintained in captivity within the same glass terrarium for 60 days. They were maintained at a natural photoperiod with a mean room temperature of 23°C and a range of 18–26°C. Basking spots, as described above, were available every day from 0930 to 1630 h.

Scale counts, body measurements (to the nearest 1 mm using a meter stick), and notes on color patterns follow those described in Klauber (1972) and Campbell and Lamar (2004). Color pattern was recorded from live individuals only, and after the first molt in the case of neonates. Character values from the holotype and two paratypes of *C. tancitarensis* were taken from Alvarado-Díaz and Campbell (2004).

Results and Discussion

Scalation and color pattern.—Table 1 lists character values of the nine specimens reported herein and of the holotype and paratypes of *C. tancitarensis*. The new material conforms well with scutellation and color pattern of type specimens, all the new material expands the range of ventral scale number (from158–160 to 151–160), subcaudal scale number (from 21–22 to 15–22) and dorsal body crossband number (from 49–51 to 48–52). The two males have fewer ventral scales than do females (151 vs. 156–160). Subcaudal scales numbers were 17 and 22 in males (vs. 15–22 in females). Tail length constitutes about 9 and 9.3% of total body length in the two males and 7.5–8.9 % in females. All specimens (including types) exhibit 21 dorsal scale rows at mid-body, a loreal scale that does not contact the lower preocular scale but contacts the supralabial scale series, and a loreal scale that is longer than high (except in INIRENA 414, in which the right loreal is as long as high). Color pattern of the new specimens is similar to type specimens; dorsal ground color pale blue-gray, dark crossbands on body and tail, and a black omega-shaped nape mark. However, neonates and juveniles lacked the pinkish copper-colored stripe along the vertebral line that is exhibited by the types and the other two adults (Fig. 1). Although the range of variation for some characters increased, lepidosis aspects and color pattern of the new material are consistent with the characters that separate *C. tancitarensis* from other members of the *C. intermedius* group (Alvarado-Díaz and Campbell 2004).

Diet in captivity.—During the first two months of captivity, the non-gravid female (INIRENA 421) was offered various types of potential prey, including invertebrates (crickets, mealworms, centipedes), amphibians (*Hyla eximia*, *H. arenicolor*), rodents (newborn mice), and lizards (*Sceloporus grammicus*, *S. aeneus*, *Anolis*

FIG. 1. Adult female (INIRENA 421) and neonates of *Crotalus tancitarensis.*

nebulosus, *Plestiodon copei*). The snake only accepted lizards, consuming all species presented except *A. nebulosus*. Lizard species known to share the local habitat with *C. tancitarensis* include *S. grammicus*, *P. copei*, and *Barisia imbricata*. *Sceloporus grammicus* is the most abundant lizard in the area, so that species is most likely the primary food source of *C. tancitarensis*. Under captive conditions described above, the snake was sustained (until death occurred 41 months after capture) on a diet of adult *S. grammicus* and juvenile *S. aeneus*, at an average feeding rate of one lizard per week.

The gravid female (INIRENA 560) was fed an adult *S. grammicus* about every 10 days after being placed in captivity on 29 October 2005. She stopped feeding in mid February 2006, about one month before parturition. After giving birth on 21 March 2006, she refused all food and died 21 days later.

Neonates refused to eat various types of prey that were similar to those offered to adults, although all vertebrate pretty offered were neonates or juveniles. After 60 days without feeding, one neonate was force-fed a liquefied *S. grammicus*, but died within an hour. The rest of the neonates were subsequently euthanized.

Camarillo and Campbell (2002) reported that captive adult *C. transversus* fed on lizards (*P. copei, S. grammicus, S. mucronatus, S. aeneus*) and mice. They also reported that captive born *C. transversus* neonates refused to eat and eventually died. However, Camarillo and Campbell (1993) earlier reported a neonate *C. transversus* that fed readily in captivity on a diet of *S. grammicus*.

Reproduction.—As mentioned above, the gravid female (INIRENA 560) captured 29 October 2005 gave birth to five young on 21 March 2006. Neonate total lengths ranged from 131 to 150 mm (mean = 143 mm) and they weighed from 2.2 to 3.2 g (mean = 2.7 g). The entire litter weighed a total of 13.7 g, and after giving birth, the mother weighed 20.5 g. When originally captured, the female weighed 40 g, indicating that at time of parturition energy reserves were low. The first molt was on the 10th day postbirth for two neonates and on the 11th day for the other two.

Numerous authors have reported litter sizes of various species of rattlesnakes (see Campbell and Lamar 2004 for a review). Smaller species generally produce fewer offspring (often 5–8) that are relatively large as compared to adults. Conversely, large species produce more young (15–40) that are relatively small as compared to adults. Litter size and relative litter mass recorded herein for *C. tancitarensis* follow this pattern, as do reported litter sizes of other members of the *C. intermedius* group. As examples, a litter of *C. intermedius* from Guerrero consisted of five young

(Armstrong and Murphy 1979), a litter of *C. transversus* from the state of México consisted of four young (Camarillo and Campbell 2002), and litter size for *C. pricei* ranges from 3 to 9 (Campbell and Lamar 2004).

To our knowledge, only five adult *C. tancitarensis* have ever been reported by scientific investigators. Of those, all were females, two are reported for the first time herein, and the three others belong to the type series. Four of the five were collected in summer (June and July) and the other in fall (October). The females collected in summer showed no signs of pregnancy or recent parturition, as would be indicated by flaccid abdomens and longitudinal skin folds on the posterior part of the body (Macartney and Gregory 1988). The sizes of the two juveniles collected in the summer suggest that they were not more than two months old. Therefore, the parturition date of the captive female and the collection date of the two juveniles suggest that the parturition season for *C. tancitarensis* extends from March to July.

Table 1. Measurements (mm) and meristic counts of *Crotalus tancitarensis*. Data for holotype and paratypes from Alvarado-Díaz and Campbell (2004). All adult specimens are female. A = adult, J = juvenile, N = neonate, SVL = snout-vent length, TL = tail length, V = ventrals, S = subcaudals, SL = supralabials, IL = infralabials, PS = scales in the prefrontal region, HL = head length, BC = body dorsal crossbands (exclusive of tail). INIRENA 571 and 575 are males.

	SVL	TL	V	S	SL	IL	PS	HL	BC
INIRENA 560 (A)	397	37	156	22	9/9	9/9	3	16.6	51
INIRENA 421 (A)	363	28	160	20	9/9	9/9	3	17	52
INIRENA 423 (J)	172	14	156	19	9/9	9/9	3	11	50
INIRENA 414 (J)	156	15	156	21	9/9	9/9	4	11	52
INIRENA 570 (N)	119	12	156	18	9/9	9/9	4	10	51
INIRENA 571 (N)	130	13	156	18	9/9	9/9	3	10	48
INIRENA 572 (N)	133	13	156	15	9/9	9/9	4	10	50
INIRENA 574 (N)	134	12	160	18	9/9	9/9	4	10.5	50
INIRENA 575 (N)	136	14	151	22	9/9	9/9	3	10.5	51
INIRENA 309 (A)*	356	29	158	21	9/9	9/9	3	17.5	51
UTA R-52401 (A)**	397	30	159	21	9/9	9/9	3	18.2	49
FMNH 39115 (A)**	410	26	160	22	9/10	9/10	4	19.2	—

* Holotype, ** Paratypes

A number of literature sources have specified parturition dates in rattlesnakes from central and southern México that coincide with the rainy season (see Campbell and Lamar 2004 for a review). The presence of adult females with no signs of reproductive activity during the summer rainy season on Cerro Tancítaro suggests that *C. tancitarensis* has a more-than-annual reproductive cycle (Wharton 1966). The high elevation inhabited by *C. tancitarensis* might also influence reproductive cycles. Other species of Neotropical viperids from highland environments exhibit biennial reproductive cycles (Camarillo and Campbell 2002; Campbell and Solórzano 1992). Additional specimens collected from throughout the year and throughout its geographic distribution are needed to substantiate or refute hypotheses delineating reproductive season in *C. tancitarensis*.

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