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Rediscovery of the Rare Autlán Long-Tailed Rattlesnake, *Crotalus lannomi*

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Among Mexico's diverse herpetofauna, the rattlesnakes (*Crotalus* and *Sistrurus*) have intrigued both herpetologists and non-herpetologists alike for centuries. One group of rattlesnakes, however, has remained especially enigmatic. The long-tailed rattlesnake group includes three rare species (*C. stejnegeri, C. lannomi,* and *C. ericsmithi*) and is represented in museum collections by fewer than 15 specimens, most of which are *C. stejnegeri* (Campbell and Flores-Villela 2008; Campbell and Lamar 2004). Their unique body structure and unusually long tails have raised numerous questions regarding their natural history and ancestry.

The Autlán Long-tailed Rattlesnake, *C. lannomi*, has been known only from a single specimen, collected in June 1966 by Joseph R. Lannom, Jr. from "1.8 miles west of the pass: Puerto Los Mazos, Jalisco" (Tanner 1966). Despite numerous attempts to locate additional specimens (Campbell and Flores-Villela 2008; Campbell and Lamar 2004), none have been reported since the initial description.

Since 2004, we have searched for rattlesnakes in the western foothills of the Sierra Madre Occidental and associated ranges in Nayarit, Jalisco, and Colima. Over the course of several weeks in July 2008, five additional specimens of long-tailed rattlesnakes were found in the foothills of Colima, México. Based on features of lepidosis, this new material is referred to *Crotalus lannomi*. The snakes were found approximately 50 km SW of the type locality (Fig. 1). Herein, we provide detailed morphological descriptions of the new specimens, notes on natural history, comparisons with the other species of long-tailed rattlesnakes, and review the conservation status of the species.

Methods

The new specimens of *Crotalus lannomi* were collected at two localities in Colima: 42 km SE (Site 1) and 48 km ESE (Site 2) by road from Cuautitlan, Jalisco (Fig. 1). Protocols for making scale counts and definitions of external morphological features follow Klauber (1972) and Campbell and Lamar (2004). Measurements were made using a meter stick to the nearest 1 mm or with a digital caliper. All specimens were photographed by digital camera (Nikon D200 and Sony Cyber-Shot F828) and the images were deposited at the University of Texas at Arlington Digital Image Collection (UTADC). One specimen was deposit at the Museo de Zoologia, Facultad de Ciencias, UNAM (MZFC 22941).

Measurements for other species of long-tailed rattlesnakes were taken from published sources (Campbell and Flores-Villela 2008; Campbell and Lamar 2004; Dunn 1919; Tanner 1966).

Results

Description of the new material.—The specimens of *Crotalus lannomi* reported herein (N = 5; 3 males, 2 females) agree in most characters with the original description by Tanner (1966). A comparison of morphological characters is given in Table 1. The following is a summary of scutellation in *C. lannomi*: rostral wider

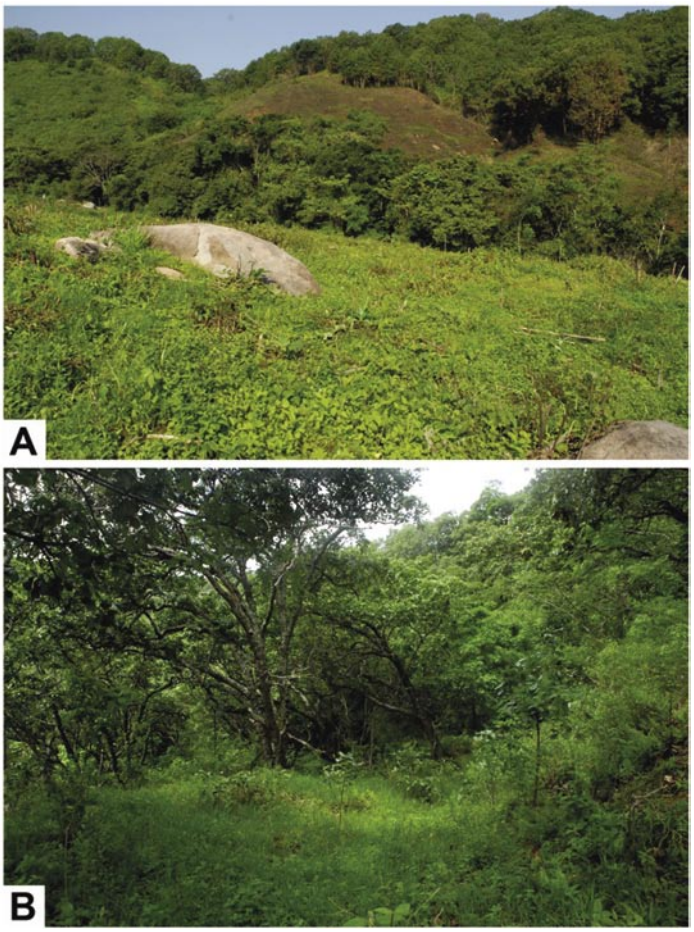

Fig. 1. New localities for *Crotalus lannomi* in Colima, Mexico. A) 42 km by road SE of Cuautitlan, Jalisco. Cleared field in open oak/TFD ecotone, 805 m elevation. B) 48 km by road ESE of Cuautitlan, Jalisco. Steep hillside in open oak/TDF ecotone, 1150 m elevation.

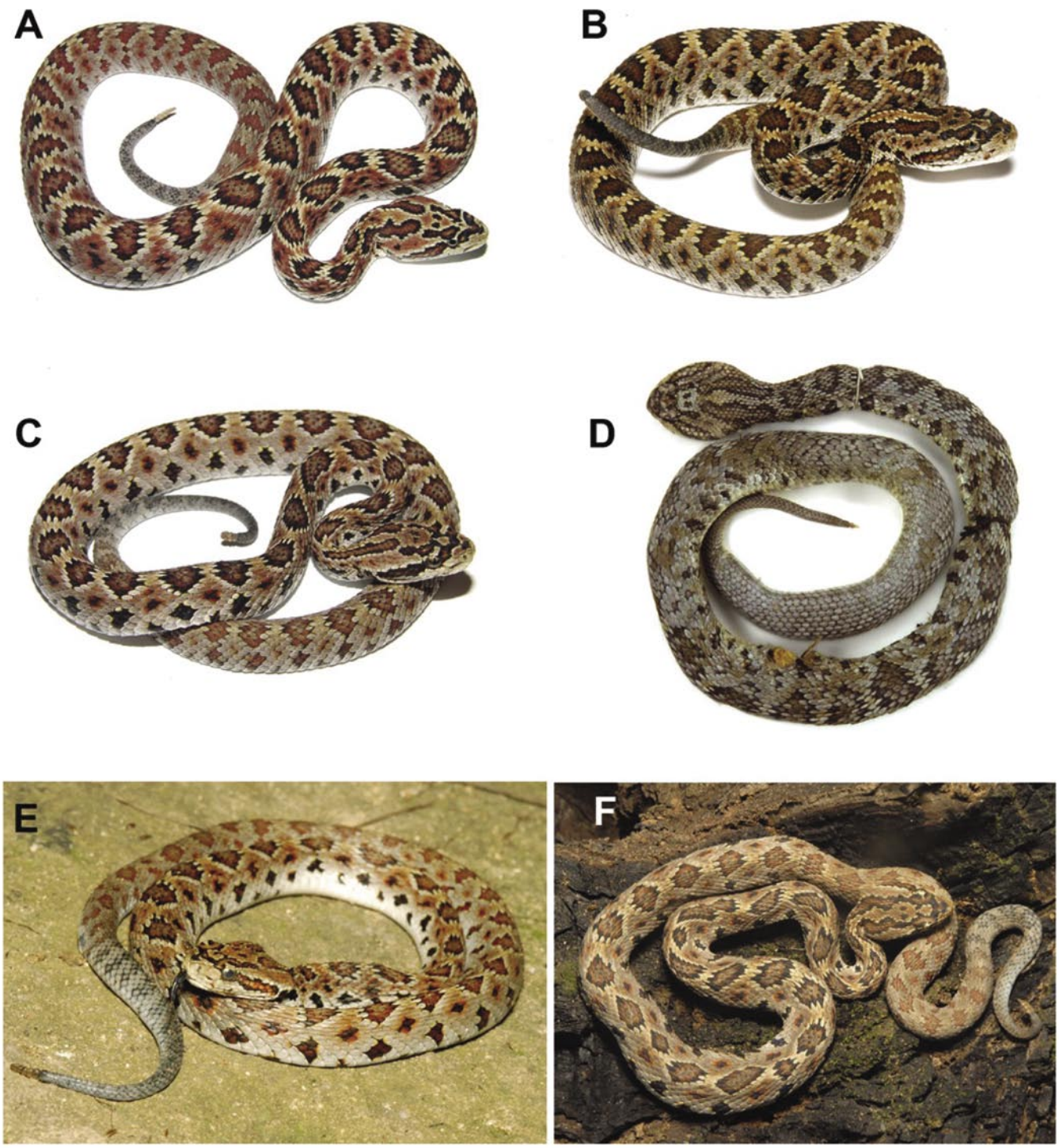

FIG. 2. Known specimens of *Crotalus lannomi*: A) UTADC-4005, female; B) UTADC-4002, female; C) UTADC-4003, male; D) BYU-23800, female, holotype; E) MZFC-22941, male; F) UTADC-4006, male.

than high; canthals moderate to large; 2–4 scales between canthals (but in two specimens canthals in contact); internasals relatively narrow; intersupraoculars 3, 4, or 5 at midlevel; 1–4 scales between intersupraoculars and intercanthals; dorsal scale rows (DSR) extremely variable: midbody 25–29; one head length behind neck 23–27; one head length anterior to cloaca 20–22; ventrals 168–175; subcaudals in males 49; in females 35–36; body slender in both sexes though slightly more stout in females.

Coloration.—In life coloration is as follows: ground color varies from rust-red to various shades of brown and yellow; dorsal blotches 31–35 (31–33 in females, 35 in males); blotches brown with central highlights and dark black or dark brown edges surrounded by a pale cream or white border one scale in width; blotches fade to pale brown or rust with the dark edges and pale border becoming indistinguishable towards the posterior part of the body; primary dorsal blotches 3–10 scales wide and 2–11 scales

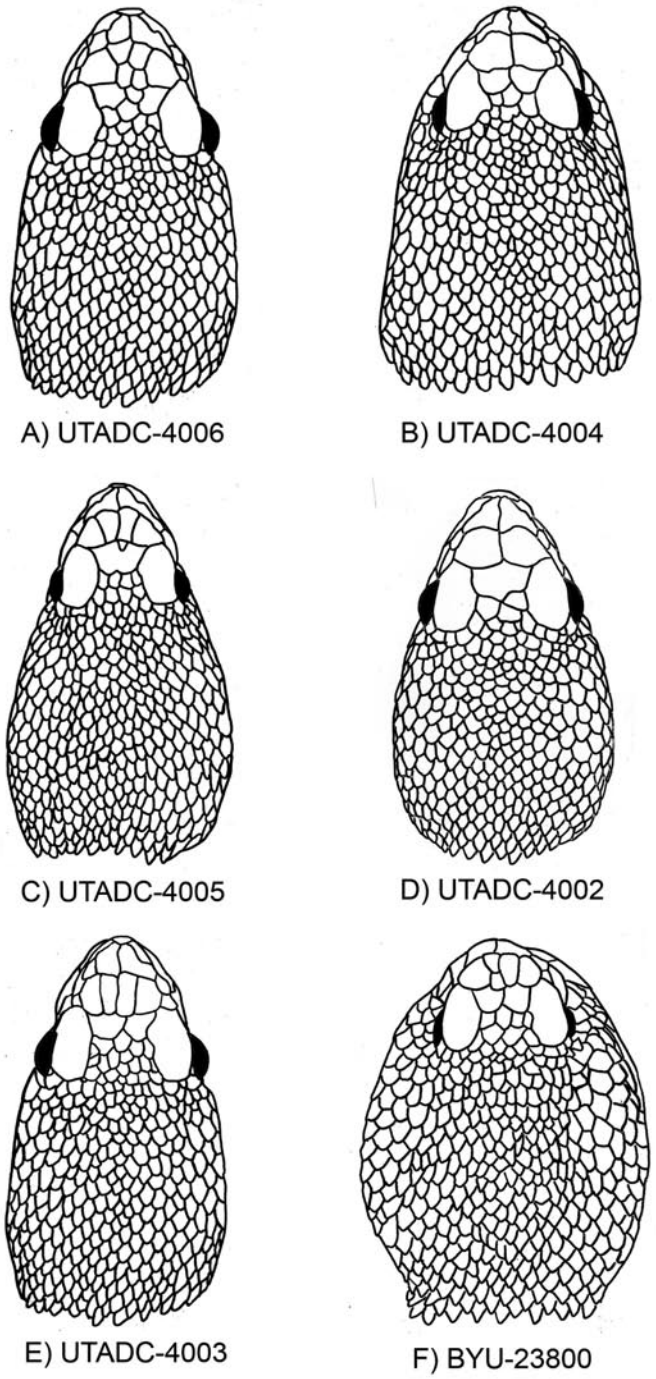

FIG. 3. Head scalation of *Crotalus lannomi*: A) UTADC 4006, male; B) MZFC 22941, male; C) UTADC 4005, female; D) UTADC 4002, male; E) UTADC 4003, female; F) BYU 23800, female, holotype (the unusual appearance can likely be attributed to the snake being run over by a vehicle).

long (9–12 scales wide and 3–5 scales long in the holotype), narrowing towards the posterior of the body; blotches separated by 0.5–4 scales; a dark brown or black spot present on both sides of each dorsal blotch, on scales 2–4; spots become paler on the posterior part of the body; a small dark lateral spot is present, usually on scale rows 4–6 between dorsal blotches, bordered by bright orange on surrounding scales; a secondary row of smaller dark lateral spots is present just above the ventrals; tail pale blue-gray, with 12–17 gray bands; venter white with an irregular series of two black spots near the margin of each ventral. In preservative most colors turn dull gray or brown.

Habitat.—Both new localities for *Crotalus lannomi* reported here are within an ecotone of tropical deciduous forest (TDF) and oak forest (Fig. 1). The area is characterized by wet canyons harboring tropical semi-deciduous forest with large old growth trees. Areas above 1200 m have medium to dense pine or pine-oak forest. Site 1, at 805 m elev., lies along an arroyo and consists of a cleared field with scattered large boulders, covered by grasses and secondary growth ca. 0.5–1 m high. It is bordered by open oak/TDF (Fig. 1A). Site 2 is a steep hillside in open oak/TDF located at 1150 m elev. (Fig. 1B). It is mostly undisturbed, with the exception of some light grazing and logging. Introduced grasses (*Panicum, Hyparrhenia, Andropogon*) and small bushes represent the principal vegetation cover at Site 1. Small bushes (*Montano* sp., *Verbesina* sp.) and some herbaceous plants (*Adiantum* sp., *Cheilanthes* sp., *Hemiontis* sp.) form the understory at Site 2. Oak trees (*Quercus magnolifolis, Q. iltisii, Q. elliptica*) and tropical arborescent species (*Bursera bipinnata, Cecopia* sp., *Lysiloma* sp., *Sapium* sp.) represent the principal tree species at both localities.

NATURAL HISTORY

Diet.—Examination of fecal samples from a juvenile specimen (UTADC 4003) revealed lizard scales (*Sceloporus* sp.), arthropod remains, plant matter, and the mandible of a colubrid snake. The colubrid mandible measures 2.3 mm in length and has two posterior fangs with deep grooves.

Reproduction.—Umbilical scars were present in the two juvenile specimens (UTADC 4002, 4003), both of which were found ca. 20 m apart on the same hillside at Site 1 on 15–16 July, respectively. An adult female and male (UTADC 4005, 4006) were found on 24 July 2008 basking together beneath grasses and small ferns at Site 2 (Fig. 1B). The previous day, a single male (MZFC 22941) was observed at this site.

Activity and behavior.—All specimens were found partially hidden beneath vegetation between 1130 and 1300 h, and were quick to rattle and retreat when disturbed. None assumed a defensive posture nor struck when handled. We spent many hours actively searching at night, both in the field and on roads, but were not able to locate any specimens. However, based on published observations of related taxa (Campbell and Flores-Villela 2008; McDiarmid et al. 1976a), we expect this species to be crepuscular and/or nocturnal when weather permits.

DISCUSSION

Comparison with other long-tailed rattlesnakes.—The paucity of specimens available for study coupled with minimal sampling over a wide geographic range has made it difficult to determine relationships within this group. Until now, two of the three species (*C. lannomi* and *C. ericsmithi)* were each known only from a single specimen. Although the specimens reported here add to our understanding of variation in *C. lannomi* (Table 2), further sampling within the expected collective range of the long-tailed species group is needed to confirm the distinctiveness of the cur-

TABLE 1. Morphological variation in *Crotalus lannomi*. Measurements for BYU 23800 were taken from Tanner (1966) and Campbell and Flores-Villela (2008). DSR = Dorsal Scale Rows.

Characters	UTADC-4004	UTADC-4002	UTADC-4006	UTADC-4003	UTADC-4005	BYU-23800
Sex	Male	Male	Male	Female	Female	Female
Rattle segments	6	2	5	2	5	2 remaining
DSR at mid body	25	29	25	29	29	27
DSR 1 head length behind head	—	28	23	27	27	31
DSR 1 head length before cloaca	20	21	21	21	22	22
Ventral scales	175	173	171	175	168	176
Subcaudals	49	49	49	35	36	37
Scales between canthals	In contact	In contact	4	2	2	3
Intersupraoculars	3	3	4	5	4	4
Body blotches	35	35	35	33	32	31
Width of blotches (in scales)	6–10	8–10	6–9	3–4	7–10	9–12
Length of blotches (in scales)	2–4	3–7	3–7	7–11	3–5	3–5
Scales between blotches	1–4	1–2	1–2	1–2	0.5–2	1.5 or less
Tail bands	17	16	12	12	15	—
Total length (mm)	541	346	603	300	612	638
SVL (mm)	470	302	516	272	548	569
Tail length (mm)	71	44	87	28	64	69
Head length (mm)	39	19	31	19	35	31.6
Tail % of total length	13.10%	12.70%	14.40%	9.30%	10.40%	10.80%

rently recognized species.

Coloration of *C. lannomi* is very similar to that of the type specimen of *C. ericsmithi*. The bright orange color of *C. ericsmithi* was one of the most distinctive characters reported in the original description (Campbell and Flores-Villela 2008). Both adult male specimens of *C. lannomi* reported here also display bright orange to reddish coloration (Fig. 2). *Crotalus stejnegeri* is significantly duller in color, although Campbell and Flores-Villela (2008) noted that some specimens had orange-colored scales.

The additional specimens of *C. lannomi* demonstrate that this species is also highly variable in scutellation (Table 1). Previous differences thought to distinguish *C. lannomi* from *C. ericsmithi* have proven unreliable, including size of canthals, number of scales between canthals, number of intersupraoculars, number of ventrals, and general head and body coloration, as all of these characters overlap considerably between the two species. The number of mid-dorsal body blotches was believed to be a distinguishing feature between *C. lannomi* and *C. stejnegeri*. The additional material described here, however, demonstrates an overlap in all three species. *Crotalus lannomi* was believed to have a more stout body than *C. ericsmithi* and *C. stejnegeri*, but this trait seems to be a sexually dimorphic condition unique to females. Conversely, we have found the following characteristics to be useful in distinguishing *C. lannomi* from the other two species of long-tailed rattlesnakes: a reduced number of scales between the intersupraoculars and intercanthals, numbering 1–4 (12 in *C. ericsmithi*, more than 10 in *C. stejnegeri*) and by having fewer prefoveals, 4 (7–8 in *C. stejnegeri;* 5–6 in *C. ericsmithi*). The first pair of infralabials is mostly separated by the mental in *C. ericsmithi*, while it is in broad contact in both *C. lannomi* and *C. stejnegeri*.

Although each of the three species of long-tailed rattlesnakes occupies a very small area, their ranges are undoubtedly far greater than presently understood (Fig. 4). All three species occur at similar elevational and vegetation associations, and in similar climate zones that can be found almost continuously along the western slopes of the sierras from northwestern Durango to Oaxaca. Here we suggest some specific areas for future field efforts, as new material from within range gaps will be important in resolving relationships within the group.

1. The coastal foothills of Guerrero and Oaxaca, south of the low pass of the Sierra Madre del Sur, located near Chilpancingo.

2. The Sierra de Coalcomán in coastal Michoacán is located between the ranges of *C. lannomi* and *C. ericsmithi* and it seems likely that at least one of these species occurs there.

3. Also warranting attention is the Balsas/Tepalcatepec Basin of Jalisco, Michoacán, México, Guerrero, and Morelos, where a humid tropical semi-deciduous forest appears on the southern slopes of the central transverse ranges.

4. No species of long-tailed rattlesnake has been reported from Nayarit, however the state likely has *C. stejnegeri* and potentially *C. lannomi*.

5. Another area of interest is the region where the states of Sonora, Sinaloa, and Chihuahua meet, where we have heard rumors of long-tailed rattlesnakes from east of Álamos, Sonora and near Cosalá, Sinaloa.

Although it is unclear why no additional specimens of *Crotalus lannomi* had been found since the original description, and why long-tailed rattlesnakes in general are so seldom found, the following factors undoubtedly serve to reduce collecting efforts in long-tailed rattlesnake habitat.

TABLE 2. Morphological variation in long-tailed rattlesnakes. Measurement for *Crotalus ericsmithi* and *C. stejnegeri* were taken from Campbell and Flores-Villela (2008).

Characters	*Crotalus lannomi*	*Crotalus stejnegeri*	*Crotalus ericsmithi*
Tail % of TL	Males, 12.7–14.4% Females, 9.3–10.8%	Males, 10.4–14.5% Female, 9.7%	Male, 15.9%
Internasals	Relatively narrow	Broad	Relatively narrow
Size of canthals	Moderate to very large	Moderate	Large
Scales between canthals and intersupraoculars	0–4 3–5	2–3 5–8	3 5
Scales between intersupraoculars and intercanthals	1–4	>10	12
Ventrals	Males, 171–175 Females, 168–175	Males, 172–178 Females, 171–176	Male, 172
Subcaudals	Males, 49 Females, 35–37	Males, 48 Females, 36–37	Male, 41
Dorsal body blotches	Males, 35 Females, 31–33	34–43	35

Social issues.—The narrow band of habitat where long-tailed rattlesnakes are found is favorable for marijuana and opium production (pers. obs.). The type locality of *C. stejnegeri*, for example, has a long history of drug-related violence, as does Mexican Hwy 40, where additional specimens of that species have been collected (Hardy and McDiarmid 1969; McDiarmid et al. 1976). The coastal sierra of Guerrero, the only known locality for *C. ericsmithi*, is an important center for narcotics production, as is the Sierra de Coalcomán in Michoacán. In general, the western sierras of Nayarit, Jalisco, and Colima are somewhat less affected, but still have areas of marijuana and opium poppy harvesting.

Roads.—There are few accessible roads through long-tailed rattlesnake habitat. There are between four and eight paved roads traversing areas inhabited by long-tailed rattlesnakes, several of which are some of the most dangerous in Mexico. Aside from poor road conditions, domestic livestock, heavy fog, rain and flooding, treacherous curves, and dangerous traffic, highway robberies and kidnappings are not uncommon. Access on dirt roads is more widespread; however, navigating them during the rainy season can be near impossible.

Conservation of Crotalus lannomi.—The tropical foothills of Colima, where the additional specimens of *C. lannomi* were found, are some of the state's last remaining wilderness areas, as most of the lowlands have been severely altered by human activity. Issues affecting the conservation of *C. lannomi* have not been studied, but here we list anthropogenic factors potentially affecting *C. lannomi* habitat:

• Agriculture.—Corn and coffee are being cultivated with some

TABLE 3. Amphibians and reptiles associated with *Crotalus lannomi* at two localities in Colima, Mexico.

Snakes	Lizards	Turtles	Amphibians
Agkistrodon bilineatus	*Ameiva undulata*	*Kinosternon integrum*	*Chaunus marinus*
Boa constrictor	*Anolis smithii*	*Rhinoclemmys pulcherrima*	*Ollotis marmoreus*
Crotalus basiliscus	*Aspidocelis linneattissimus*		*Craugastor augusti*
Dryadophis melanolomus	*Elgaria kingii*		*Craugastor hobartsmithii*
Drymobius margaritiferus	*Eumeces parvulus*		*Eleutherodactylus nitidus orarius*
Enulius flavitorques	*Heloderma horridum*		*Exerodonta smaragdina*
Leptodeira maculata	*Phyllodactylus lanei*		*Gastrophryne usta*
Leptotyphlops humilis	*Sceloporus bulleri*		*Hyla arenicolor*
Manolepis putnami	*Sceloporus utiformis*		*Pachymedusa dacnicolor*
Masticophis mentovarius	*Sphenomorphus assatus*		*Rana forreri*
Micrurus proximans			*Smilisca baudini*
Trimorphodon biscutatus			*Tlalocohyla smithii*
Trimorphodon tau			
Tropidodipsas annulifera			

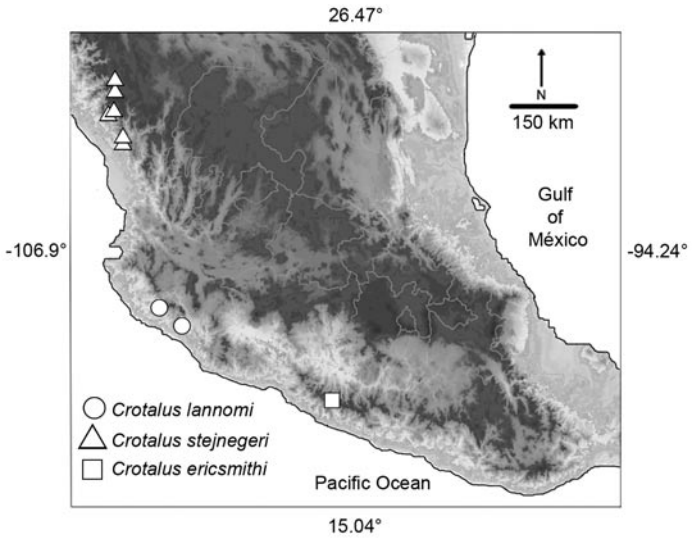

FIG. 4. Distribution of species of the long-tailed rattlesnake group in western Mexico.

frequency at Site 1. However, general inaccessibility and rough terrain limit the threat to most of this area.

• Cattle grazing.—Small-scale cattle grazing is common at both sites. Animals are usually free ranging and feed on native vegetation and introduced grasses. Some hillsides are considerably eroded, presumably due to overgrazing.

• Logging.—Minimal logging for charcoal production occurs in the vicinity of both localities.

• Mining.—Several active ore mines are found throughout the known and predicted range of *C. lannomi*. The expansion of these mining operations represents a potential risk to *C. lannomi* and its habitat.

Crotalus lannomi is listed as threatened by the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). This is equivalent to the vulnerable category as defined by the IUCN. Although these rankings are assumed to be similar, this species is listed as "data deficient" in the IUCN Red List of Threatened Species (Ponce-Campos and Garcia-Aguayo 2007) rather than vulnerable. We consider *C. lannomi* vulnerable throughout its very limited known range.

Several species of unique plants and animals share the habitat with *Crotalus lannomi*. The tree *Inga colimana* (Fabaceae) is endemic to the area (Padilla Velarde et al. 2005). The Peregrine Falcon (*Falco peregrinus*) is known to nest at similar elevations in western Colima (Santana et al. 2006). This represents the southernmost reported nesting site for the species. At least one Puma (*Puma concolor)* was observed while searching for snakes at night. Some 716 species of plants are reported from a nearby sierra, and of those, 16 are considered to be in some kind of risk category and two are endangered (Padilla-Velarde et al. 2008). We believe that the west-central foothills of Colima should be protected to ensure the conservation not only of *Crotalus lannomi* but the rich flora and fauna sharing its habitat. Further studies are necessary to understand the ecology and natural history of this elusive species and to promote its conservation.

Type locality of Crotalus lannomi.—After an interview with Joseph R. Lannom, Jr. (interviewed by JRV on 6 February 2009), collector of the holotype of *C. lannomi*, it seems likely that the original locality reported in Tanner (1966) is in error. During the interview, Lannom described the type locality of *C. lannomi* as a bridge where the highway crosses a lush canyon, which he referred to as "Wildcat Canyon." A canyon fitting his description, known locally as "Arroyo el Tigre" is located at 550 m elevation, 12 km SW by road from the locality given in Tanner (1966). This locality lies within the TDF/oak forest ecotone. This difference might explain why searches at the published type locality, situated in a more arid oak forest, have failed to produce additional specimens.

Common name of Crotalus lannomi.—Tanner (1966) suggested the name "Autlán Rattlesnake" for *C. lannomi*. This name was later changed to "Autlán Long-tailed Rattlesnake" by Campbell and Flores-Villela (2008). The city of Autlán de Navarro, Jalisco, is located a short distance from the type locality of *C. lannomi* (ca. 13 airline km NE), but boasts habitat and climatic conditions significantly different from those at all known collection sites. The city is located in the rain shadow of the Sierra Manantlán, and the habitat is a dry, desert-like thornscrub. We believe it unlikely that *C. lannomi* would inhabit the area surrounding the city of Autlán, and therefore consider the name "Autlán Long-tailed Rattlesnake" inappropriate for this species. Given that both the type locality and the abovementioned collection sites are located in, or associated with, the Sierra de Manantlán, we propose the name "Manantlán Long-tailed Rattlesnake" for *C. lannomi*.

Herpetofauna associated with Crotalus lannomi.—A number of amphibians and reptiles were found at or in proximity to the new localities given here for *Crotalus lannomi*. Table 3 summarizes the herpetofaunal species found at these localities. Most are typically lowland inhabitants, but several (*Elgaria kingii*, *Sceloporus bulleri, Exerodonta smaragdina,* and *Hyla arenicolor*) are mid-elevation or highland species in west-central Mexico.

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