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Cantils of Hidalgo and Veracruz, Mexico, with Comments on the Validity of *Agkistrodon bilineatus lemosespinali*

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ABSTRACT.—The taxonomic placement of cantils from Veracruz and Hidalgo, Mexico, has remained uncertain based on the small number of samples available from these areas. We examined the scutellation and color pattern of three new specimens of *Agkistrodon taylori* from northeastern Hidalgo and adjacent Veracruz and compared these results with the morphology of other *A. taylori* and the single specimen of *Agkistrodon bilineatis lemosespinali* from the coastal area of central Veracruz. Our results indicate very little morphological deviation from the range of variation previously reported for *A. taylori*. In addition, the single specimen of *A. b. lemosespinali* does not appear to represent *A. taylori*, contrary to a previous report. However, whether or not it deserves formal recognition as a subspecies distinct from other *Agkistrodon bilineatus* remains questionable. The presence of *A. bilineatus* along the eastern coast of Mexico in Veracruz provides support for a previous hypothesis of transcontinental dispersal of *A. bilineatus*.

RESUMEN.—La ubicación taxonómica de los cantiles de Veracruz e Hidalgo, México, ha permanecido incierta basada en el pequeño número de muestras disponibles de estas áreas. Examinamos la escutelación y el patrón de color de tres especimenes recientes de *Agkistrodon taylori* para el noreste de Hidalgo y un área adyacente en Veracruz, y comparamos estos resultados con la morfología de otro *A. taylori* y el único espécimen de *Agkistrodon bilineatus lemosespinali* del área costera del centro de Veracruz. Nuestros resultados indican muy escasa desviación morfológica a partir del rango de variación previamente referido para *A. taylori*. En adición, el único espécimen de *A. b. lemosespinali* no parece representar *A. taylori*, contrario a un previo reporte. Sin embargo, sí es o no, ésta merece reconocimiento formal como una subespecie distinta de otra *Agkistrodon bilineatus* permaneciendo cuestionable. La presencia de *A. bilineatus* a través de la costa Este de México en Veracruz provee apoyo a una hipótesis previa de dispersión transcontinental de *A. bilineatus*.

Only two specimens of cantil have previously been reported from Hidalgo and Veracruz, Mexico (Blair et al., 1997; Smith and Chiszar, 2001; Tovar-Tovar and Mendoza-Quijano, 2001; Campbell and Lamar, 2004). However, the taxonomic placement of these two specimens remains uncertain. Smith and Chiszar (2001) described a new subspecies of cantil, *Agkistrodon bilineatus lemosespinali*, based on one specimen from Veracruz. Concurrently, Tovar-Tovar and Mendoza-Quijano (2001) documented a single specimen of *Agkistrodon taylori* from nearby Hidalgo but did not provide any data on its morphology. In part because of the geographic proximity of the Hidalgo specimen, Campbell and Lamar (2004) treated *A. b. lemosespinali* as a synonym of *A. taylori*. They also stated that the diagnostic characters used to distinguish *A. b. lemosespinali* from other cantils fell within the normal range of variation for *A. taylori*. Because of the large hiatus that exists between populations of *A. taylori* in northeastern Mexico and *A. bilineatus* in southwestern Mexico and along the Yucatán Peninsula, the systematic placement of cantils from the intermediate localities of Hidalgo and Veracruz is important in helping to determine the phylogeography of this group. Herein, we report on the scutellation and color pattern of several specimens of cantil from Hidalgo and Veracruz, including the specimen cited by Tovar-Tovar and Mendoza-Quijano (2001). We compare these results with *A. taylori* and the single specimen of *A. b. lemosespinali* and comment on the taxonomic validity of *A. b. lemosespinali*.

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MATERIALS AND METHODS

Specimens examined (Appendix 1) are deposited in the ITAH (Instituto Technológico Agropecuario de Hidalgo) and UTA (University of Texas at Arlington) herpetological collections. The sex of the specimens was determined by making a small subcaudal incision posterior to the anal plate to determine the presence or absence of a hemipenis. All measurements were made to the nearest 0.1 mm with a dial caliper. Scale counts were made with the aid of a dissecting microscope. Color descriptions were made from alcohol-preserved specimens and field notes before preservation.

RESULTS AND DISCUSSION

Three specimens of *A. taylori*, deposited in the ITAH collection, are available from Hidalgo and adjacent Veracruz (Fig. 1). These localities are about 200 km southeast of the nearest reported specimen of *A. taylori* from Naranjo, San Luis Potosí (Gloyd and Conant, 1990), and about 200 km northwest of the type locality of *A. b. lemosespinali*. The first specimen (ITAH 535), reported in Tovar-Tovar and Mendoza-Quijano (2001), is an adult male 521 mm TL from Coyolapa, Municipality of Atlapexco, Hidalgo. The second specimen (ITAH 579) is a female neonate,

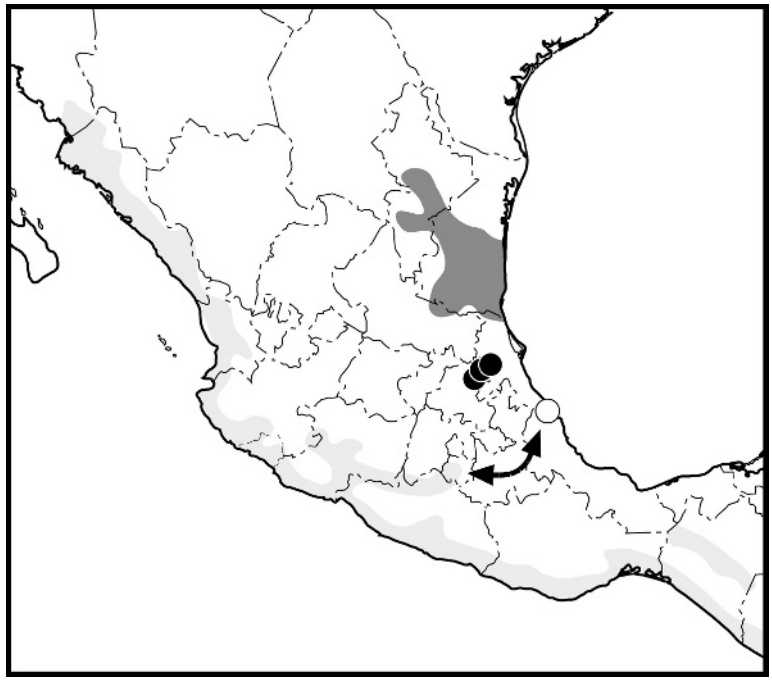

FIG. 1. Distribution of *Agkistrodon taylori* (dark gray) and *Agkistrodon bilineatus* (light gray) in Mexico (modified from Campbell and Lamar, 2004). Filled circles represent the localities of three specimens of *A. taylori* from Hidalgo and Veracruz deposited in the Instituto Tecnológico Agropecuario de Hidalgo (ITAH) herpetological collection; hollow circle indicates the locality of the single specimen of *Agkistrodon bilineatus lemosespinali*. Arrowed line depicts the relative position of a narrow band of seasonally dry forest mapped by Gloyd and Conant (1990:60) that may have acted as a dispersal corridor for *A. bilineatus*.

235 mm TL, from El Moreno, Municipality of Huejutla de Reyes, Hidalgo. The third specimen (ITAH 580) is a juvenile female 341 mm TL that was collected near Tantoyuca, Municipality of Tantoyuca, Veracruz. All were found in secondary vegetation in areas containing tropical deciduous forest. These snakes are in general agreement in color and pattern with *A. taylori* (Gloyd and Conant, 1990). In all three of the specimens, the pale line below the eye on the side of the head begins at the first nasal and extends downward across the supralabials and covers the lower lingual edge of the supralabials. This line is relatively broad and is not separated from the commissure by dark pigment. The pale upper stripe begins at the rostral and continues across the lateral margins of the internasals, prefrontals, and supraoculars, downward across the upper postocular and first horizontal row of temporals to the posterior edge of the jaw. There is a broad, vertical white stripe on the rostral and mental that extends from the mental across the edges of the first infralabials and chin shields. This well-defined stripe forks after the chin shields to meet a light line that extends downward from the fifth or sixth infralabials. The color and pattern of the adult male in life was much brighter than is typical for male *A. taylori*, which are usually dark with a relatively obscure pattern (Gloyd and Conant, 1990). In addition, most of the 15 dark cross-bands in the adult male have lighter gray centers. However, because the snake is a small adult, there may be remnants of the juvenile coloration and patterning. The two females exhibit the typical juvenile pattern found in *A. taylori* (Gloyd and Conant, 1990) and are strongly patterned with 15 light-centered cross-bands.

As with color and pattern, the scutellation of the three specimens of ITAH *A. taylori* falls close to or within the documented range of variation for *A. taylori* as described by Gloyd and Conant (1990; Table 1). The notable exception is the number of subcaudals in the juvenile female (54), which is a higher number than has been recorded for female *A. taylori* (40–47). In addition, the ratio of tail length to total length in the adult male (20%) slightly exceeds that of previously measured male *A. taylori* (16–19%). The head of the adult male is damaged; therefore, some scales could not be counted with accuracy. However, the number and arrangement of the head scales in the remaining two ITAH specimens are within the normal range of variation. The scales in the prefrontal-internasal area are subdivided and number more than the usual four (six in one snake, and nine in the other). Gloyd and Conant (1990) noted that aberrations of the crown plates occurred in most of the specimens of *A. taylori* that they examined; thus, such subdivisions are not unusual. Thus, the ITAH specimens examined deviate very little in external morphology from *A. taylori* from Nuevo León, Tamaulipas, and northern San Luis Potosí.

Smith and Chiszar (2001) described *A. b. lemosespinali* on the basis of one specimen collected on 29

TABLE 1. Morphological variation among *Agkistrodon taylori*, three specimens of *A. taylori* from Hidalgo and Veracruz deposited in the Instituto Tecnológico Agropecuario de Hidalgo (ITAH) herpetological collection, and the single male *Agkistrodon bilineatus lemosespinali*. Data for *A. taylori* and *A. b. lemosespinali* taken from Gloyd and Conant (1990) and Smith and Chiszar (2001), respectively. Characters denoted with an asterisk are considered to be diagnostic among the species (Gloyd and Conant, 1990; Smith and Chiszar, 2001).

	A. taylori		ITAH *A. taylori*		*A. b. lemosespinali*
Character	Males (*N* = 27)	Females (*N* = 17)	Males (*N* = 1)	Females (*N* = 2)	Males (*N* = 1)
Supralabials	8, sometimes 7 or 9	8, sometimes 7 or 9	—	7–9	8–9
Infralabials	10–11, sometimes 9 or 12	10–11, sometimes 9 or 12	—	10	11
Ventrals	127–137	130–138	130	133, 134	138
Subcaudals*	45–56	40–47	54	54, 45	61
Midbody dorsal scale rows	23, rarely 21	23, rarely 21	23	23	23
Tail/total length	16–19%	13–18%	20%	16, 17%	15.3%
Cross-bands	11–16	11–16	15	15	uncountable
Supralabial lines to commissure*	yes	yes	yes	yes	no
Continuity at tip of snout of pale lines	usually no	usually no	no	no	yes
Pale lines on head broad	yes	yes	yes	yes	no

December 1970 from ''north of Palma Sola,'' Veracruz. The imprecise locality and condition of the single specimen resulting from age has called into question the validity of this species description. Campbell and Lamar (2004) suggested that the morphological characters used to diagnose *A. b. lemosespinali* are within the known range of variation for *A. taylori* and, subsequently, treated *A. b. lemosespinali* as a synonym of *A. taylori*. However, as seen in Table 1, regardless of the precise locality, those morphological characters that can be accurately counted and that are not influenced by age suggest that the single specimen of *A. b. lemosespinali* does not represent *A. taylori*. In particular, as stated by Smith and Chiszar (2001), the specimen has a pale line across the supralabials that is dark-bordered ventrally and that does not reach the commissure (vs. a broad pale line that extends across the lingual edges of the supralabials) and more subcaudals than *A. taylori* (61 vs. 45–56 in males). Gloyd and Conant (1990) considered a pale line that reaches the commissure and a lower number of ventrals to be diagnostic for *A. taylori*. The Palma Sola snake is further separated from *A. taylori* by its proportionately shorter tail and unity of narrow, pale lines at the tip of its snout (Table 1).

In addition to the above, Smith and Chiszar (2001) also list several other characters that diagnose *A. b. lemosespinali* from other cantils. These include the presence of eight symmetrical scales in the prefrontal/internasal area, a snout longer than the frontal, and dark coloration with no vestiges of cross-bands. Of these, perhaps none are of relative importance, especially in a sample size of one, because they represent character states frequently found in other subspecies of *Agkistrodon bilineatus*. Gloyd and Conant (1990) found occasional subdivision of the internasals and prefrontals, making the importance of more than the typical four scales in the prefrontal/internasal area character suspect. Furthermore, Smith and Chiszar's (2001) claim that a snout longer than the frontal in *A. b. lemosespinali* distinguishes it from other cantils is also problematic. We found no evidence for this claim in the literature other than the diagram alluded to in Gloyd and Conant (1990) by Smith and Chiszar (2001), which depicts the dorsal and lateral views of a specimen of *Agkistrodon bilineatus bilineatus*. The measurements of four specimens of *A. bilineatus* from Costa Rica and one specimen from Colima indicate a snout that is longer than the frontal (for a list of the specimens examined, see Appendix 1). Finally, the dark coloration of the Palma Sola specimen is not unique given that it is a large adult male and may, in fact, also be an artifact of long-term storage in preservative. Gloyd and Conant (1990:82) commented that large specimens of *Agkistrodon bilineatus russeolus* tend to darken over time in preservative, especially if they were exposed to formalin for a long time. In general, adult male *A. bilineatus* are very dark dorsally, a condition that increases with size and age (Gloyd and Conant, 1990; Campbell and Lamar, 2004).

Although *A. b. lemosespinali* is different than *A. taylori*, is it different than other *A. bilineatus*? Of the distinguishing characters cited by Smith and Chiszar (2001) and discussed above, only in the ratio of tail length to total length does *A. b. lemosespinali* differ unequivocally from all other subspecies of *A. bilineatus*. The tail length to total length in male *A. bilineatus* varies from 17–27%; in the single specimen of *A. b. lemosespinali*, it is 15.3%. Without the collection of more material from the coastal areas of central Veracruz, it is difficult to surmise whether the observed differences in tail length to total length, or any of the other characters purported to be unique in *A. b. lemosespinali* by Smith and Chiszar (2001), are diagnostic for this population and, even then, whether they warrant formal recognition. Parkinson et al.

(2000) found comparatively little genetic differentiation in the small number of *A. bilineatus* they sampled. Sequence divergence among the subspecies sampled ranged from 0.4–1.9% for 1765 base pairs of mitochondrial DNA sequenced (Parkinson et al., 2000). Certainly, however, the locality of the single specimen of *A. b. lemosespinali* appears to be isolated from other known populations of *A. bilineatus*. However, if *A. b. lemosespinali* inhabited the area directly around Palma Sola, it is likely now extinct because of habitat degradation (Smith and Chiszar, 2001). This underscores the importance of properly allocating the Palma Sola snake since additional materials from this area may not become available. At present, this specimen appears to be most closely related to, if not conspecific with, *A. b. bilineatus*. Both the Palma Sola specimen and *A. b. bilineatus* differ from *A. b. russeolus* and *Agkistrodon bilineatus howardgloydi* in the continuity at tip of snout of supraocular and supralabial light lines (vs. interrupted in the latter two subspecies; Smith and Chiszar, 2001).

As mentioned by Smith and Chiszar (2001), the remote possibility exists that the single specimen of *A. b. lemosespinali* was actually collected from within the range of *A. b. bilineatus* and somehow ended up in the collectors' hands at Palma Sola. Although this cannot be discounted, the percentage of undivided subcaudal scales in the Palma Sola snake is suggestive of an origin in southern Mexico northwest of Guatemala and east or northeast of Guerrero. Gloyd and Conant (1990) found clinal variation in the number of undivided subcaudal scales in cantils along the west coast of Mexico and Guatemala. The average percentage of undivided subcaudals in males was lowest in the northwest at 25.8–41.5% and steadily increased to an average of 57.3–67.4% in southern Mexico and Guatemala. The percentage of undivided subcaudals in the male Palma Sola specimen is 52%, which is slightly higher but closest to the number found in males examined by Gloyd and Conant (1990) from Morelos and Guerrero (mean 48.7%). Interestingly, Gloyd and Conant (1990:60) mapped out a narrow band of seasonally dry forest favorable for cantils that extends from northern Guerrero and Morelos across Puebla into Veracruz, where it is divided by the Sierra Madre Oriental before terminating along the coast of Veracruz in a narrow patch that includes the locality of Palma Sola (Fig. 1). Therefore, it would stand to reason that, if this was indeed a corridor for dispersal, any populations of *A. bilineatus* east or northeast of Morelos and Guerrero should have a slight increase in the number of undivided subcaudals. Such is the case in the Palma Sola specimen. This has interesting biogeographic implications because such a corridor of dispersal helps to corroborate Parkinson et al.'s (2000) suggestion of a transcontinental dispersal hypothesis for *A. bilineatus* and provides a route for the dispersal of cantils to the Pacific lowlands of Mexico.

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Appendix 1

List of the specimens examined in this study. *Agkistrodon bilineatus bilineatus*: MEXICO: Colima: Tamala (UTA R-4501). *Agkistrodon bilineatus howardgloydi*: COSTA RICA: Guanacaste: Guanacaste Conservation Area, Sector Santa Rosa, Administrative Area (UTA R-42837-39). *Agkistrodon taylori*: MEXICO: Hidalgo: Coyolapa, Municipality of Atlapexco (ITAH 535); El Moreno, Municipality of Huejutla de Reyes (ITAH 579). Veracruz: near Tantoyuca, Municipality of Tantoyuca, Veracruz (ITAH 580).