NUMBER 52 20 APRIL 1979

OCCASIONAL PAPERS OF THE MUSEUM OF ZOOLOGY

LOUISIANA STATE UNIVERSITY

BATON ROUGE, LOUISIANA

THE RELATIONSHIP OF THE GROUNDSNAKES *SONORA SEMIANNULATA* AND *S. EPISCOPA* (SERPENTES:COLUBRIDAE)

By DARREL R. FROST[1] AND THOMAS R. VAN DEVENDER[2]

Sonora semiannulata and *S. episcopa* were distinguished by Stickel (1938, 1943), the last revisor of the genus, on the basis of a few characters of scutellation. The seemingly minor differences between the two species in western Texas and northern Mexico, the region of sympatry as mapped by both Conant (1975) and Stebbins (1966), led us to review their status. The pertinent subspecies of *S. semiannulata* is *S. s. blanchardi*, which ranges as far east as the eastern limits of the Chihuahuan Desert[3] in New Mexico, Trans-Pecos Texas, and the Mexican states of Coahuila and Nuevo Leon (Conant, 1975; Liner, 1964; Stebbins, 1966). *S. e. episcopa* extends west from the Great Plains region into Trans-Pecos Texas and northern Coahuila (Savitzky and Collins, 1971), where it contacts *S. s. blanchardi*. *S. e. taylori*, which is discussed briefly, is found in southern Texas and northeastern

[1] Museum of Zoology, Louisiana State University, Baton Rouge, Louisiana 70893. Current address: Museum of Natural History and Department of Systematics and Ecology, University of Kansas, Lawrence, Kansas 66045.

[2] Department of Geosciences, University of Arizona, Tucson, Arizona 85721.

[3] We have not followed Morafka's (1977) delineation of the Chihuahuan Desert because, in our opinion, much of the area he refers to as desert in eastern New Mexico and west-central Texas is, in fact, desert-grassland. Our concept of the Chihuahuan Desert is more conservative than his and is approximated most closely by R. H. Schmidt's unpublished map of the Chihuahuan Desert (Figure 1).

Mexico. The diagnostic characteristics of these subspecies are summarized in Table 1.

Materials and Methods

We examined 128 specimens of *Sonora* from the area bounded by southern Arizona and Chihuahua on the west, Coahuila and central Texas on the east. The characters studied were those used by Stickel to separate *S. s. blanchardi* from *S. e. episcopa*: the numbers of dorsal scale rows (both at midbody and 3 scales before the vent), ventrals (counting from first wider than long), and subcaudals. The few adequately everted hemipenes available were also compared. When possible, specimens were grouped on the basis of morphological and habitat similarities into sample populations for statistical comparison.

Results and Discussion

Our results are summarized in Table 2 and Figure 1. The character displacement expected when two discrete but very closely related species come into contact was not observed. All characters examined showed evidence of intergradation between *Sonora e. episcopa* and *S. s. blanchardi.*

The mean number of ventrals increases more-or-less clinally from *Sonora e. episcopa* through *S. s. blanchardi* with no evidence of a break indicative of a species boundary (Table 2). The number of subcaudals was the most important character employed by Stickel to distinguish *S. e. episcopa* as a species distinct from *S. s. blanchardi* because it is the *only* character in which there is no overlap (Table 1). There can be no intermediacy in this character because a one scale difference in the subcaudal count changes the identification from *S. e. episcopa* to *S. s. blanchardi.* Subcaudal counts of *S. e. episcopa* and *S. s. blanchardi* form a geographic continuum correlated with habitat aridity, increasing gradually along an ecological gradient from relatively mesic central Texas (sample 1) into the extremely xeric Chihuahuan Desert (*e.g.*, samples 7, 8, and 9) and decreasing again in the grasslands west of the Chihuahuan Desert where *S. s. blanchardi* intergrades with *S. s. isozona* (sample 18). Specimens collected in intermediate biotic communities, grassland to desert-grassland (samples 3, 4, 10, and 11), have intermediate subcaudal counts. Clayton J. May (personal communication) detected the same relationship between habitat aridity and subcaudals in *S. semiannulata* in southeastern Arizona. We are unfamiliar with local vegetation patterns in Coahuila, Mexico, but suspect that the correlation

Table 1. Diagnostic features of *Sonora semiannulata blanchardi, S. episcopa episcopa,* and *S. e. taylori* (from Stickel, 1938)

	S. s. blanchardi	*S. e. episcopa*	*S. e. taylori*
1. Temporals	1+2	1+2	1+1
2. Dorsal scale rows	near vent 14, very rarely 13 or 15; usually 15 at midbody	near vent 15 in 90%, 14 in 10%; 15 at midbody	near vent 13; at midbody 13, rarely 14
3. Ventrals	♂♂ $\bar{x}$=151(147-155) ♀♀ $\bar{x}$=160(157-166)	♂♂ $\bar{x}$=147(134-156) ♀♀ $\bar{x}$=153(140-162)	♂♂ (126-144) ♀♀ (136-153)
4. Subcaudals	♂♂ $\bar{x}$= 56(53-59) ♀♀ $\bar{x}$= 48.5(46-51)	♂♂ $\bar{x}$ 43.5(39-52) ♀♀ $\bar{x}$= 37(31-44)	♂♂ (39-50) ♀♀ (35-41)

between subcaudals and biotic community exists there also.

Sonora s. blanchardi and *S. e. episcopa* differ in the number of dorsal scale rows (Table 1). Since dorsal scale rows in *Sonora* reduce by loss of one vertebral or paravertebral row at a time, *S. s. blanchardi* is intermediate between the two races of *S. episcopa* from each of which it differs by only one scale row reduction. The point of scale row reduction in those specimens that have the 15-14 pattern may occur anywhere from the anterior half of the body to just before the vent with no discernible geographic trend. However, there is evidence of intergradation between those populations which have the 15-14 pattern (*S. s. blanchardi* and races to the west) and those which have 15-15 (*S. e. episcopa*). Although Stickel (1938) reported that only 10% of *S. e. episcopa* have the 15-14 pattern, the actual frequency of this pattern varies geographically with a general increase from east to west. Of the *S. e. episcopa* from the Langtry, Texas, area (sample 4), 28% have the 15-14 pattern. Farther to the west, 50% of the Davis Mountain sample (sample 10) have the 15-14 pattern. Both of the *S. e. episcopa* from eastern New Mexico (sample 11) reduce to less than 15 scale rows before the vent; the Roswell specimen (TCWC 33936) has 15-14 and the specimen from Carlsbad (UAZ 40637) has 15-13. An eastern *S. s. blanchardi* from near Van Horn, Texas (sample 12), has the 15-15 pattern typical of *S. e. episcopa.* As far west as Arizona occasional specimens exhibit the 15-15 pattern (UAZ 39571, sample 18). Although subcaudal number will allocate specimens of *Sonora* from the Cuatro Ciénegas region of Coahuila (sample 14) to either *S. s. blanchardi* or *S. e.*

FIGURE 1. Sample populations of *Sonora* studied. The numbers assigned correspond with those in Table 2. The shaded area approximates the limits of the Chihuahuan Desert (adapted from Schmidt, unpublished map).

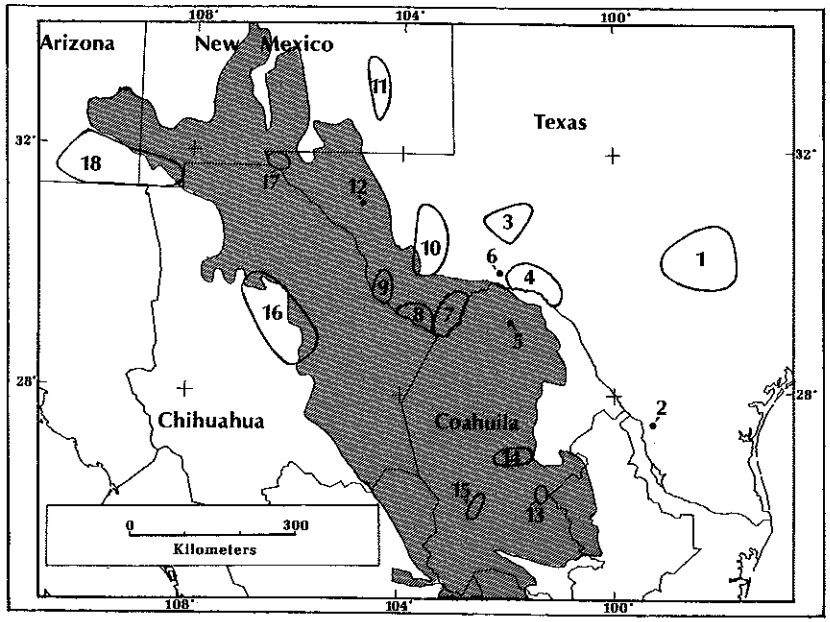

TABLE 2. GEOGRAPHIC VARIATION IN VENTRALS, SUBCAUDALS, AND DORSAL SCALE REDUCTION PATTERN IN SAMPLES OF *Sonora* STUDIED (SEE FIGURE 1). DATA ARE REPORTED AS MEAN ± $s_{\bar{x}}$ (RANGE OF VARIATION) SAMPLE SIZE. MALES ARE REPORTED OVER THE BAR, FEMALES BELOW.

Sample	Ventrals	Subcaudals	% sample with less than 15 scale rows near vent
1.	134.7±0.95 (132-136) 4	40.2±0.75 (39-42) 4	28.6
	146.7±0.88 (145-148) 3	36.0±1.53 (33-38) 3	
2.	(136) 1	(43) 1	100.0[1]
3.	(135-147) 2	(45-49) 2	40.0
	154.7±0.88(153-156)3	40.3±2.19 (36-43) 3	
4.	146.2±0.85 (136-154) 21	47.9±0.54 (44-53) 20	28.0
	156.0±1.15 (154-158) 3	44.3±1.45 (42-47) 3	
5.	(146) 1	(49) 1	100.0
6.	(144-152) 2	(55-57) 2	50.0
7.	147.2±1.26(142-152)8	52.6±1.53 (46-57) 7	75.0
	158.7±2.84 (153-165) 4	47.0±3.51(40-51)3	
8.	152.1±1.09 (143-158) 14	55.5±0.92 (51-60) 13	100.0
	(166) 1	(52) 1	
9.	150.7±0.84 (148-154) 6	53.0±0.52 (52-55) 6	100.0
	160.3±2.33 (158-165) 3	(48-49) 2	
10.	147.0±1.13(143-152)7	48.0±1.24 (43-51) 6	50.0
	(157) 1	(40) 1	

[1] LSUMZ 27716 is 13-13.

11.	(149) 2	(49) 2	100.0
12.	(154) 1	(54) 1	0.0
13.	150.5±2.72 (143-155) 4 (163) 1	53.0±1.41 (49-54) 4 (50) 1	100.0
14.	145.2±0.99 (140-150) 10	52.1±0.91 (47-57) 10	100.0
15.	156.0±1.73 (153-159) 3 (163) 1	54.0±2.65 (50-59) 3 (49) 1	0.0
16.	151.5±1.04 (149-154) 4 (163-165) 2	53.0±0.71 (52-55) 4 (45-48) 2	100.0
17.	151.0±0.93 (147-153) 6 (160) 1	52.0±0.82 (49-54) 6 (54) 1	100.0
18.	156.0±1.58 (152-161) 5 164.3±0.88 (163-165) 3	49.0±2.07 (45-55) 5 43.7±2.40 (39-47) 3	87.5[2]

episcopa, none of the *S. e. episcopa* (7 of the 10 specimens) have the 15-15 pattern; instead they have the 15-14 pattern. The four *S. s. blanchardi* examined from southwestern Coahuila (sample 15) have the *S. e. episcopa* pattern of 15-15.

No differences between *Sonora e. episcopa* and *S. s. blanchardi* were seen in the few hemipenes examined (n=7).

We have shown that the characters used by Stickel to separate *Sonora episcopa* and *S. semiannulata* are insufficient, the subspecies of *S. episcopa* becoming (as anticipated by Dowling, 1959, and Morafka, 1977) *S. semiannulata episcopa* and *S. s. taylori*. The arbitrary separation of the subspecies *S. s. blanchardi* and *S. s. episcopa* is untenable because the only difference of value, subcaudal count, varies ecotypically. Synonymizing *S. s. blanchardi* with *S. s. episcopa* removes any symmetry from the subspecies framework of *S. semiannulata* since these two subspecies are more distinctive than are most of the other subspecies (*gloydi*, *isozona*, *linearis*, *semiannulata*, and *taylori*) or the dubiously distinct species *S. mosaueri* and *S. bancroftae*, both of Baja California (Stickel, 1938; Klauber, 1943). Pending an evaluation of geographic variation from throughout the entire range of the species, we prefer to consider *S. semiannulata* to be a highly variable species with no subspecies.

[2] UAZ 39569, 39575 have scale rows alternating between 14 and 15 near the vent.

ACKNOWLEDGMENTS

We are indebted to the following people and their institutions for the loan of specimens: Carol M. Kruse and George Burdick, Big Bend National Park (BBNP), C. J. McCoy, Carnegie Museum (CM), Douglas A. Rossman, Louisiana State University Museum of Zoology (LSUMZ), James F. Scudday, Sul Ross State University (SRSU), James R. Dixon, Texas A & M University (TCWC), Charles H. Lowe and John K. Cross, University of Arizona (UAZ), and Robert G. Webb and Richard D. Worthington, University of Texas at El Paso (UTEP). James Scudday kindly relinquished his interest in this study to us. John Cross supplied data from some of the Arizona material. Clayton J. May, Tucson, Arizona, gave us information on variation in Arizona *Sonora*. Robert H. Schmidt, University of Texas at El Paso, supplied us with his unpublished delineation of the Chihuahuan Desert. Lynne Frost, Douglas A. Rossman, and J. Michael Fitzsimons read various stages of the manuscript and offered helpful suggestions. Larry D. Wilson, Miami-Dade Community College, and James R. Dixon served as reviewers. The following people went out of their way to collect *Sonora* for us: Glenn Guidry, Stephen Hale, Ron Savage, Wayne Van Devender, and Henry Wallace. Financial support for T. R. Van Devender was provided by National Science Foundation grants #DEB 75-13944 to Paul S. Martin, Department of Geosciences, University of Arizona, and #DEB 76-19784 to Van Devender.

SPECIMENS EXAMINED

ARIZONA: Cochise Co.: 2 mi. SE Dos Cabezas, UAZ 39571; 4 mi. SSE Dos Cabezas, UAZ 39570; 6.5 mi. N Douglas airport, UAZ 26369; Fort Huachuca, UAZ 39572; Sierra Vista, UAZ 39569; 2.5 mi. S Sonoita, UAZ 39577; Graham Co.: 29 mi. NW Willcox, UAZ 39568. NEW MEXICO: Chaves Co.: 4.5 mi. W Roswell, TCWC 33936; Eddy Co.: 6.9 mi. S Carlsbad, UAZ 40637; Grant Co.: Little Hatchet Mts., UTEP 1843. TEXAS: Brewster Co.: Alpine, SRSU 2030, TCWC 27459; 1 mi. E Alpine, SRSU 1994; 3 mi. W Alpine, SRSU 1995; 10.6 mi. W Alpine, LSUMZ 23289; 13 mi. SE Panther Jct., SRSU 2674; Panther Jct., BBNP 3881; Big Bend Nat. Park, TCWC 27457, 44115; Jct. Basin Rd., BBNP 442; Rio Grande Village, BBNP 440; Castolon, BBNP 4058; 3 mi. E Lajitas, UAZ 35252; 3.4 mi. E Lajitas, LSUMZ 34721; 4 mi. E Lajitas, UTEP 2859; Study Butte, UAZ 40512, 42370; 6-8 mi. N Study Butte, UAZ 32528, 40515; 3.2 mi. W Study Butte, UAZ 40513; 5 mi. W Study Butte, UAZ 40514; Terlingua, SRSU 1568; 10 mi. W La Linda, SRSU 2807; 9.7 mi. W La Linda, TCWC 48587; 1.4 mi. N FM 2627 on Hwy. 385, TCWC 48590; Black Gap Wildlife Management Area, 5 mi. E Hq., TCWC 48589; 12.9 mi. NW Black Gap Hq., UTEP 2856; 60 mi. S Marathon, Black Gap, TCWC 18348; Culberson Co.: 10 mi. N Van Horn, TCWC 217; El Paso Co.: El Paso, UTEP 22, 173, 226, 570, 786, 2692; 6 mi. N El Paso, CM 24971; Gillespie Co.: 14 mi. E Fredericksburg, SRSU 1604-05, 1675-76; Hays Co.: 3 mi. S. Wimberly, LSUMZ 5853; Fern Bank Spring, LSUMZ 7246; Pecos Co.: 7 mi. E Bakersfield, TCWC 27458; Presidio Co.: Presidio, TCWC 33271-72; 5 mi. SE Presidio, SRSU 2302, 3559; 5 mi. N Presidio, UAZ 32725; 8 mi. NW Presidio,

SRSU 3558; 3 mi. SE Presidio, TCWC 27900; 9.4 mi. W Redford, LSUMZ 23288; 3 mi. W Lajitas, SRSU 2947; 11.8 mi. W Lajitas, LSUMZ 34722; 17 mi. W Lajitas, SRSU 1996; Rock House Spring, SRSU 2647; 9 mi. S Marfa, SRSU 16061; 4 mi. NE Shafter, LSUMZ 23287; Reagan Co.: 2 mi. S Best, SRSU 1594-95; Reeves Co.: 2 mi. SW Balmorhea, UTEP 185; N Lake Balmorhea, SRSU 1998; Terrell Co.: 4 mi. W Dryden, TCWC 33931; 5 mi. W Dryden, TCWC 44132; 21 mi. SE Dryden, LSUMZ 23290; 23 mi. SE Dryden, TCWC 33935; 14 mi. S Sheffield, TCWC 33934; 12 mi. S Sheffield, TCWC 33938; Travis Co.: Austin, UAZ 26335; Val Verde Co.: 1 mi. W Comstock, UAZ 32724; 4 mi. W Comstock, TCWC 5991; 10 mi. W Comstock, TCWC 21651-52; 13 mi. N Comstock, SRSU 1633; 14.4 mi. N Comstock, UTEP 2857; 5.4 mi. NW Comstock, UTEP 2858; 20 mi. NW Comstock, TCWC 33930; 1.5 mi. WNW Comstock, UAZ 26338-39; Langtry, TCWC 40076-78, 48586, UAZ 40399, SRSU 2260; 3 mi. E Langtry, SRSU 2805; 11 mi. N Langtry, TCWC 40075; 1 mi. E Pecos River on Hwy. 90, UAZ 30907, 32189, 32214, 40400; Pumpville, SRSU 1631; Webb Co.: 10 mi. N Aguilares, LSUMZ 27716. MEXICO: Chihuahua: 14 mi. NE Aldama, CM 60079; 30.3 mi. NE Aldama, CM 61796; 5 km SW Cd. Chihuahua, CM 60082; 6 mi. N El Sauz turnoff on Mex. 45, CM 60080-81; 45.2 mi. W El Sueco, UAZ 35135; Coahuila: 1.6 mi. E Cuatro Ciénegas, CM 51184; 5.2 mi. E Cuatro Ciénegas, TCWC 38987; 1.5 mi. N Cuatro Ciénegas, CM 48239; 3 mi. N Cuatro Ciénegas, CM 42819; 32.6 mi. S Cuatro Ciénegas, UAZ 37797; 32.7 mi. S Cuatro Ciénegas, UAZ 37798; 33.4 mi. S Cuatro Ciénegas UAZ 37796; 0.3 mi. N Cuesta La Muralla, UAZ 42146; 5.4 mi. SSW La Madrid, TCWC 44380; 3.9 mi. E Sacramento, CM 42820; 3.0 mi. NE Sacramento, TCWC 44381; 0.7 mi. W San Juan de Boquillas, UAZ 40398; 1.7 mi. S San Lázaro, UAZ 37745; 5.2 mi. S San Lázaro, UAZ 39871; 10.3 mi. S San Lázaro, UAZ 39872; 33 mi. N San Pedro de las Colonias, CM 60078; 1.5 mi. N Santa Teresa, UAZ 42145; Sierra Babía, SRSU 1518.

Literature Cited

Conant, R.
1975. A field guide to reptiles and amphibians of eastern and central North America. 2nd ed. Houghton Mifflin Company, Boston.

Dowling, H. G.
1959 [1958]. The groundsnake, *Sonora episcopa*, in Arkansas. Southwest. Nat., 3: 212-237.

Klauber, L. M.
1943. A new snake of the genus *Sonora* from Lower California, Mexico. Trans. San Diego Soc. Nat. Hist., 10: 69-70.

Liner, E. A.
1964. Notes on four small herpetological collections from Mexico. I. Introduction, turtles and snakes. Southwest. Nat., 8: 221-227.

Morafka, D. J.
1977. A biogeographical analysis of the Chihuahuan Desert through its herpetofauna. Dr. W. Junk B. V., Publishers. The Hague, Netherlands.

Savitzky, A. H., and J. T. Collins
1971. The groundsnake *Sonora episcopa episcopa* in Coahuila, Mexico. J. Herp., 5: 87-88.

Stebbins, R. C.
1966. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston.

Stickel, W. H.
1938. The snakes of the genus *Sonora* in the United States and Lower California. Copeia, 1938: 182-190.

———.
1943. The Mexican snakes of the genera *Sonora* and *Chionactis* with notes on the status of other colubrid genera. Proc. Biol. Soc. Washington, 56: 109-128.