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THE GEOGRAPHIC VARIABILITY OF THE SPECIES *Lichanura trivirgata* AND A DESCRIPTION OF A NEW SUBSPECIES

David E. Spiteri

INTRODUCTION

Lichanura trivirgata, officially known as the rosy boa (Collins et al., 1982), is one of two boid snake species found in the United States, and has a fossil history which dates to the Miocene (Brattstrom, 1958; Holman, 1977). It ranges from Baja California and western Sonora, Mexico, north into western Arizona and southern California. *L. trivirgata* can be found in habitats ranging from the coastal sage scrub and chaparral to deserts and is typically rare from areas above 4000 feet in elevation.

The species is characterized by having small scales on the head between the oculars, smooth body scales, infraoculars (if present) in a single row, vertical pupils, and undivided anal plate, pelvic spurs on each side of the vent (absent or reduced in females), and both lungs well developed.

The species *Lichanura trivirgata* is variable in scalation, evenness of the stripes, colors of the stripes, interspaces, and ventrum. These variations have been used to differentiate four subspecies: *L. t. trivirgata*, *L. t. roseofusca*, *L. t. gracia*, and *L. t. bostici*.

Cope (1861) gave the first description of *Lichanura trivirgata*. It was captured from the Cape region of Baja California Sur, Mexico. He described the color of the three stripes as being deep liver brown. The common name became the Three Lined Boa.

Cope (1868) described two more species of *Lichanura* from "... the northern part of Lower California". These were unfortunately described with only two sentences each in the same paragraph. *Lichanura roseofusca*, the Rosy Boa, was described as being brown above with no mention of stripes, 7 or 8 oculars with one large preocular. *Lichanura myriolepis*, the Many-scaled Boa, was described as having three rusty red stripes and 10 oculars of equal size. Cope (1891, 1900) stated that *L. myriolepis* was proposed from, and represented by, San Diego specimens. Stejneger (1891) considered *L. myriolepis* to be well within the scale count limits of *L. roseofusca* and therefore invalidated *L. myriolepis* even though he only had a total of nine specimens of *Lichanura* for comparative study.

Stejneger (1889) described two more species, *L. orcutti* and *L. simplex*, both from San Diego County. Klauber (1931) invalidated *L. orcutti* and Stejneger (1891) claimed *L. simplex* to be invalid.

Klauber (1931) described *Lichanura roseofusca gracia*, the Desert Rosy Boa, based on nine specimens; three from the Mojave Desert of California and six from the western half of Arizona. The diagnostic characteristic was the even edges of the stripes in contrast to the background. This subspecies is currently considered to be valid. Spiteri (1987) and Yingling (1982) questioned the validity of this subspecies.

Miller and Stebbins (1964) made *Lichanura* monospecific, *Lichanura trivirgata*, with three subspecies: *trivirgata*, *roseofusca*, and *gracia*. They gave no explanation of their decision. Gorman (1965) questioned this action.

Ottley (1978) described *Lichanura*

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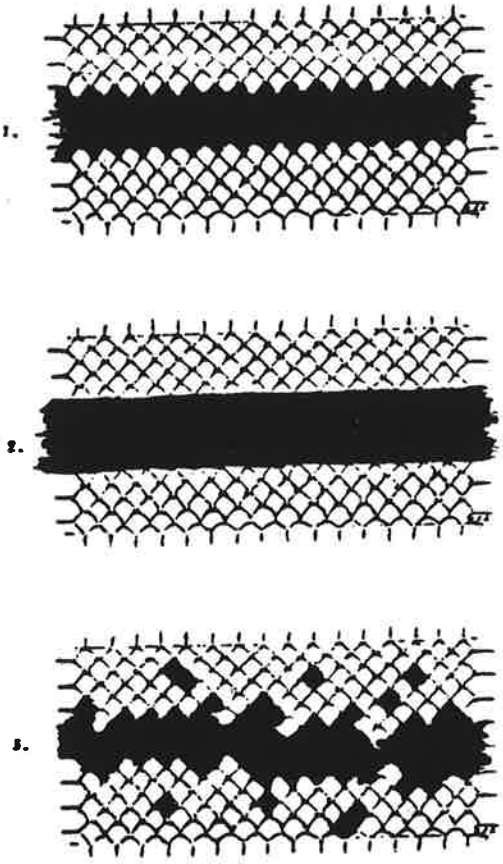

Figure 2. Three different forms of the dorsal stripe edge. 1. evenly serrated, 2. even stripe, 3. uneven stripe.

1985), a package designed for use through MS-DOS and Macintosh microcomputers. The variables subjected to MANOVA include:

VENTRL - number of ventrals;
CAUDAL - number of caudals;
ANTBOD - number of body scale rows at approximately ten ventrals posterior to the head;
MIDBOD - number of body scale rows at approximately mid-body;
POSBOD - Number of body scale rows at approximately ten ventrals anterior to anal plate;
SUPLAB - number of supralabials;
INFLAB - number of infralabials;
OCULAR - number of scales in contact with eye (oculars);
INFROC - number of scales between the oculars and the supralabials;
STR ED - the difference between the narrowest and widest scale rows included in the dorsal stripe at mid-body (stripe edge);
PREOCU - the number of enlarged preoculars.

RESULTS

Area A: All snakes had an extremely uneven dorsal stripe that varied from one to seven scales wide, sometimes even in the same individual. These snakes were also widely variable in coloration. The interspaces were spotted with the color of the dorsal stripe. The colors of the stripes that have been documented include shades of brown to shades of orange (Stebbins, 1985; Wright and Wright, 1957). The interspaces have been called steel blue to shades of gray (Stebbins, 1985; Wright and Wright, 1957). Uniformity in color and pattern was noted for individuals captured in the same locality. Specimens from southwestern San Diego County (Fig. 3) were noticeably darker than others collected from this area. The contrast of the stripes was also noted to increase with specimens from the eastern and northern parts of this area. In the San Gabriel Mountains (Los Angeles County) the contrast was the greatest with the color of the dorsal stripe approximating Color 40, Cinnamon-Rufous, and that of the interspace approximating Color 86, Pale Neutral Gray.

A few individuals from the southern part of San Diego County, south of the city of San Diego, were lacking a distinct dorsal stripe. The interspace was not the gray or blue-gray typical of this area but was a shade of brown slightly different from the shade of brown of the dorsal stripe.

Area B: All three forms of dorsal stripe pattern were found in specimens from this area. All had contrasting stripes (e.g., Fig. 4). Most living specimens from this area had less contrast between the stripes and the interspace and a less even stripe than snakes from the southern side of the San Gabriel Mountains (Area A).

Area C (Fig. 5): These snakes showed a stronger contrasting color pattern than those from the Mojave Desert (Area B). Of 29 snakes, 23 had dorsal stripes which were considered uneven (jagged), five had an evenly serrated stripe and one (LACM 20284) had a very even stripe. Snakes collected from Corn Springs, Riverside County, were

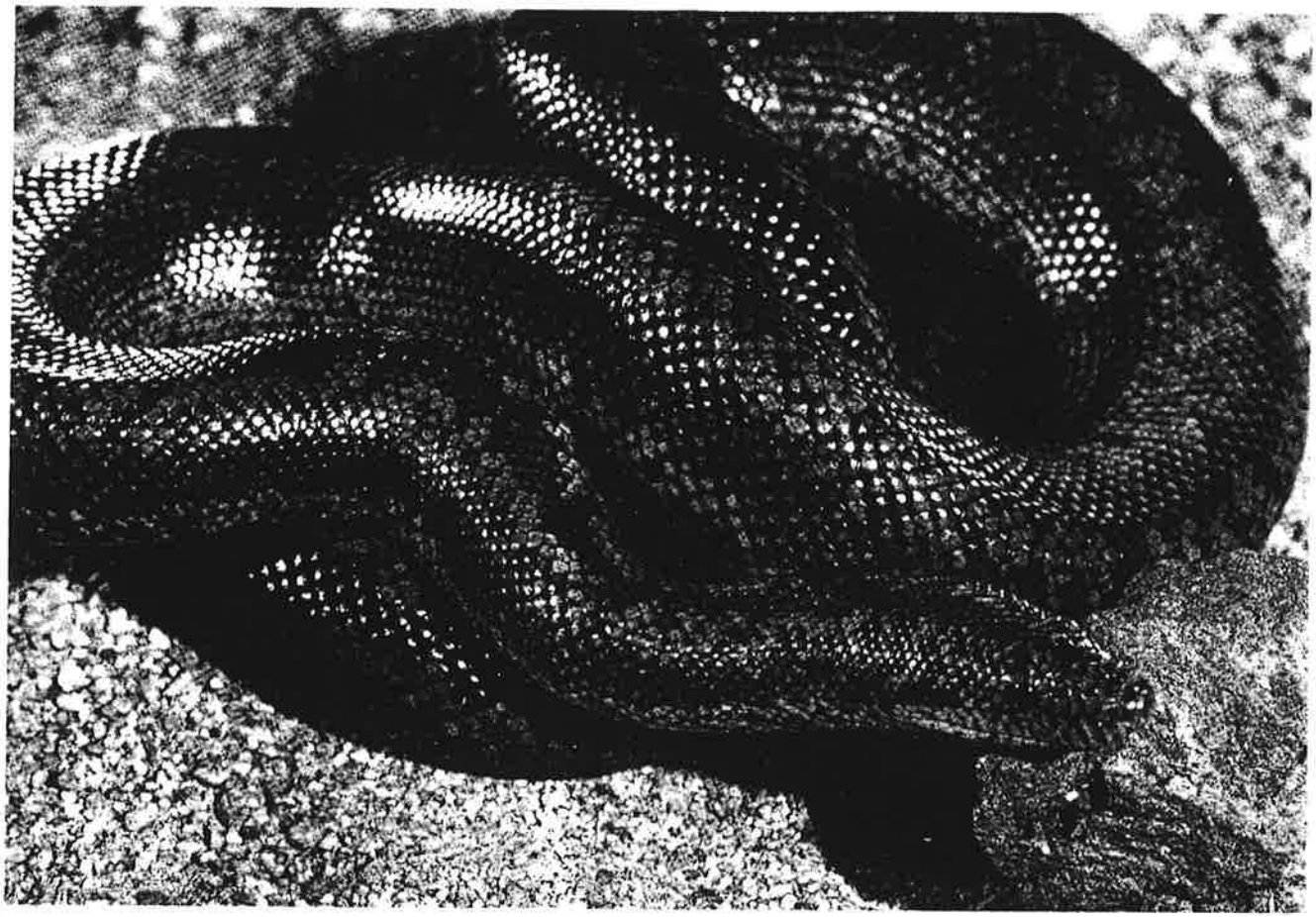

Figure 3. Adult male *Lichanura t. roseofusca* from southwestern San Diego County, California (Area A). Photo by author.

particularly striking, their dorsal stripe approximated Color 38, Tawny; and the interspace approximated Color 44, Smoke Gray. The individuals from Scissors Crossing, San Diego County, had a contrasting brownish stripe which was extremely uneven. Individuals from this area, collected from the exact same locality had predominantly similar color and pattern.

Area D: The snakes were uniform in color and pattern having an uneven dorsal stripe ranging from three to seven scales wide (Fig. 6). The stripes of these snakes showed great contrast to the interspace and their color was similar to snakes from Corn Springs, Riverside County.

Area E: Eight had even stripes and five had uneven stripes. No living samples were available for color analysis.

Area F (Fig. 7): Snakes from this area were found to have either even or uneven stripes. The coloration of these individuals varied considerably. Adult snakes from the Kirkland - Hillside area, Yavapai County, had even orange stripes with black flecks in the interspace. Young snakes up to two feet in length had a dorsal stripe color of dark brown. Snakes from the Kofa Mountains, Yuma County, had an extremely uneven brown stripe in strong contrast to the interspace. One individual Kofa Mountains specimen (DES 83-14-3) had an uneven stripe from three to seven scales wide (Fig. 8). The colors approximated Color 34, Russet, for the stripes and Color 81, Pearl, for the interspace. Specimens from the Kofa Mountains had a similar pattern to

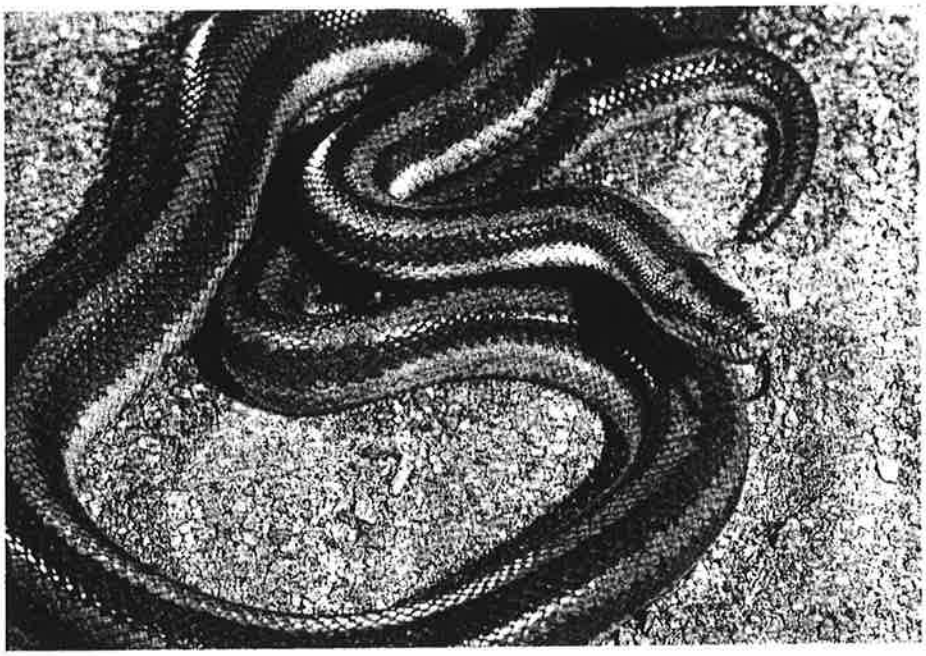

Figure 4. Adult male *Lichanura t. gracia* from the Granite Mountains, San Bernardino County, California (Area B). Photo by author.

those found in eastern San Diego County, but the Kofa Mountains specimens had more color contrast.

Area G (Fig. 9): The one living specimen (DES 87-3-1) had a uniform color dorsally approximating Color 33, Cinnamon Brown; the ventrum approximated Color 6, Salmon, with light bars (Fig. 10). The ventral color was also present ventrolaterally. All preserved specimens had a drab brown appearance with virtually no stripes.

Area H (Fig. 11): All specimens had distinct and contrasting even stripes, which was even obvious on preserved specimens. On living specimens, the stripes resembled Color 32, Chestnut, and some were outlined in black. The interspace resembled Color 79, Glaucous, and the ventrals Color 44, Smoke Gray. The snakes from the vicinity of Bahia de los Angeles, Baja California Norte, had eyes which were similar in coloration to the dorsal stripe. Personal observation showed that the young of snakes from this area are born with unmarked ventrals which may become spotted or barred as the snake becomes older. This characteristic was not noted for any individuals from other areas. The adult snakes from the vicinity of San Felipe, BCN, retained the unmarked ventrals.

Area I: These specimens typically had very dark even or evenly serrated stripes. One individual from Todos Santos, Baja California Sur, (SDSNH 49969) did have a very uneven dorsal stripe. Living specimens had stripes which approximated Color 19, Dusky Brown. Yingling (1982) called these stripes black. The interspace was a beige or cream color giving these specimens a strong contrasting appearance. All others had an even or evenly serrated dorsal stripe (Fig. 12). A strong contrast of coloration was noted for the preserved specimens from this area.

Area J: Specimens from this area were extremely similar in color and pattern to those of Area I. The means for the ventrals are higher than that of Area I (Table 1). This is probably due to the reproductive barrier caused by the Sea of Cortez. Other univariate

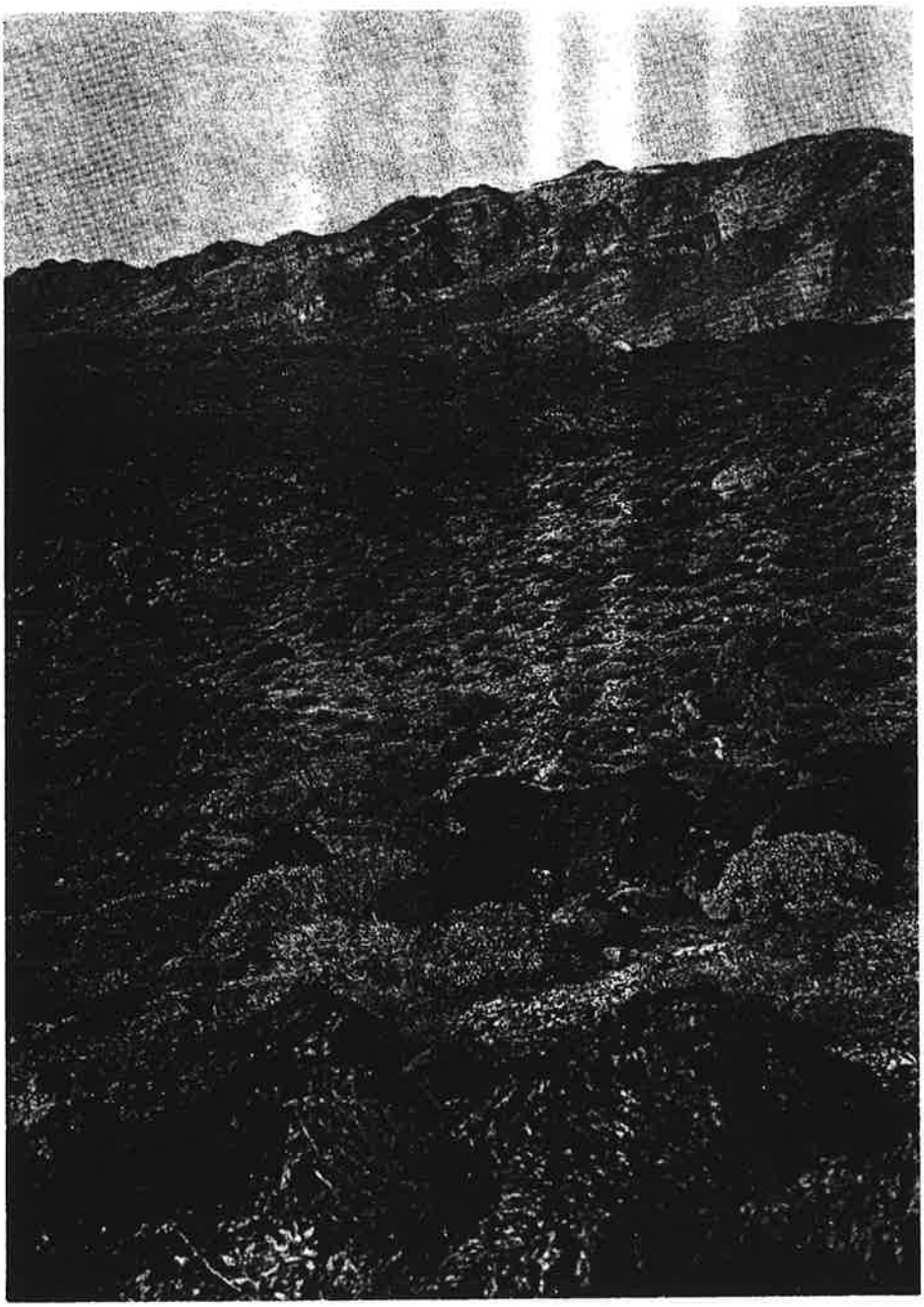

Figure 5. Habitat of *Lichanura t. gracia* in the Chuckwalla Mountains, Riverside County, California (Area C). Photo by author.

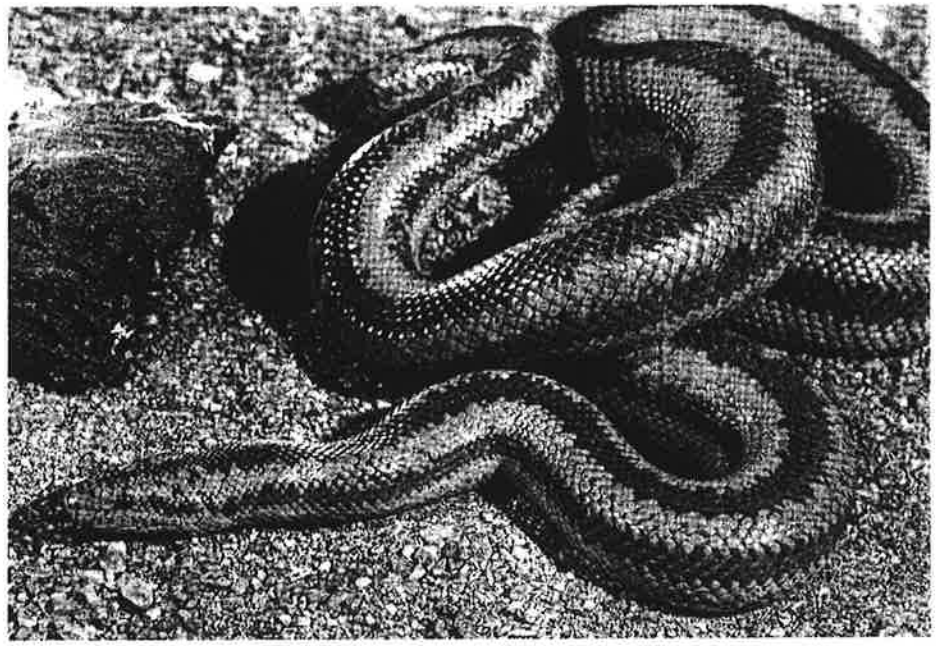

Figure 6. Adult male *Lichanura t. gracia* from the vicinity of Whitewater, Riverside County, California (Area D). Photo by author.

analyses appear to be similar to Area I (Table 1). The color of the dorsal stripe of individuals of this area has been noted as being black (Fowlie, 1965).

The snakes from area A and G are currently considered to be *L. t. roseofusca* (Wright and Wright, 1957; Yingling, 1982). The snakes from areas B,C,D,E,F and H are currently considered to be *L. t. gracia* (Bostic, 1971; Welch and Bury, 1984; Wright and Wright, 1957; Yingling, 1982). The snakes of areas I and J are currently considered to be *L. t. trivirgata*. *Lichanura t. bostici* (Ottley, 1978) is described from only four specimens as having a black dorsal stripe, 10 or more scale rows from the ventrals to the dorso-lateral stripes, and higher means for the ventrals and subcaudals. *L. t. bostici* is found only on Isla Cedros which is located off the western coast of Baja California Norte, Mexico.

The scale count data from Areas B,C,D,E,F and H were subjected to MANOVA. The results showed that the caudal scale counts, posterior body scale rows count, and the number of enlarged preoculars were not significant enough to differentiate between areas ($P>0.05$) (Table 2). The remaining eight variables were subjected to DA. Table 3 shows the coefficients for each variable in each canonical vector. Figure 13 is a scatterplot of group centroids for the first canonical axis (CA1) and the second canonical axis

TABLE 1. Means, range, and standard deviation of some scale counts of *Lichanura trivirgata* by geographic areas (see text). Rows are the areas. Columns are the variables. Bilaterally symmetrical scale counts are added together.

AREA		VENTRL	CAUDAL	ANTBOD	MIDBOD	POSBOD	SUPLAB	INFLAB	OCULAR	INFRAO
A	means	234.77	46.81	36.06	41.38	26.67	27.46	30.79	18.83	2.73
n=40	range	225-245	38-52	32-40	39-44	26-29	25-31	28-34	15-23	0-7
	SD	4.516	2.598	1.465	1.104	0.694	1.091	1.414	1.562	2.110
B	means	232.44	45.28	37.00	42.11	26.50	27.72	30.94	18.67	2.22
n=20	range	227-236	42-48	35-40	38-46	25-29	25-30	28-33	17-20	0-6
	SD	2.502	1.602	2.118	1.875	1.295	1.227	1.349	1.085	1.700
C	means	236.52	45.22	36.82	41.63	26.68	27.74	31.78	19.00	1.96
n=29	range	227-245	41-51	32-40	38-45	25-29	25-30	29-36	16-22	0-6
	SD	3.867	2.118	2.058	1.573	1.038	1.318	1.423	1.569	1.605
D	means	234.69	45.15	36.85	41.69	26.46	27.77	30.62	19.69	1.07
n=14	range	228-241	41-50	35-38	40-44	25-28	25-30	29-33	17-22	0-4
	SD	4.309	2.340	1.068	1.494	0.967	1.423	1.193	1.316	1.256
E	means	235.23	44.39	37.77	40.46	26.00	28.39	31.08	19.23	3.00
n=13	range	226-241	40-48	33-39	38-43	24-28	27-30	27-34	18-22	1-7
	SD	4.285	2.063	1.589	1.450	1.000	1.121	1.847	1.166	1.871
F	means	231.36	44.64	36.50	41.79	26.64	30.29	32.43	20.64	2.93
n=14	range	224-241	41-47	35-39	39-45	25-28	26-33	30-36	18-23	0-4
	SD	4.088	1.781	1.160	1.847	0.929	2.016	1.785	1.216	1.439
G	means	228.12	45.58	35.23	39.69	25.69	27.89	30.58	17.19	0.39
n=29	range	222-234	41-50	32-38	36-41	23-28	26-30	28-33	14-20	0-2
	SD	3.037	2.043	1.505	1.463	1.320	0.816	1.206	1.855	0.637
H	means	226.05	43.21	35.30	41.45	25.90	27.95	30.65	20.80	0.90
n=39	range	215-234	41-48	31-38	39-44	24-29	25-31	27-33	17-23	0-2
	SD	5.125	3.570	1.895	1.468	1.119	1.395	1.631	1.508	0.852
I	means	218.57	43.67	35.00	39.95	25.52	26.33	29.05	20.05	0.33
n=28	range	210-225	36-47	32-39	38-42	24-27	25-30	26-32	19-21	0-2
	SD	4.249	2.887	2.100	1.322	1.123	1.111	1.627	0.590	0.658
J	means	223.88	45.77	34.88	40.35	26.29	28.00	29.82	20.53	0.18
n=21	range	216-229	42-50	33-38	39-42	25-28	25-30	27-32	18-22	0-1
	SD	3.655	2.333	1.317	0.931	0.686	1.225	1.667	1.125	0.393

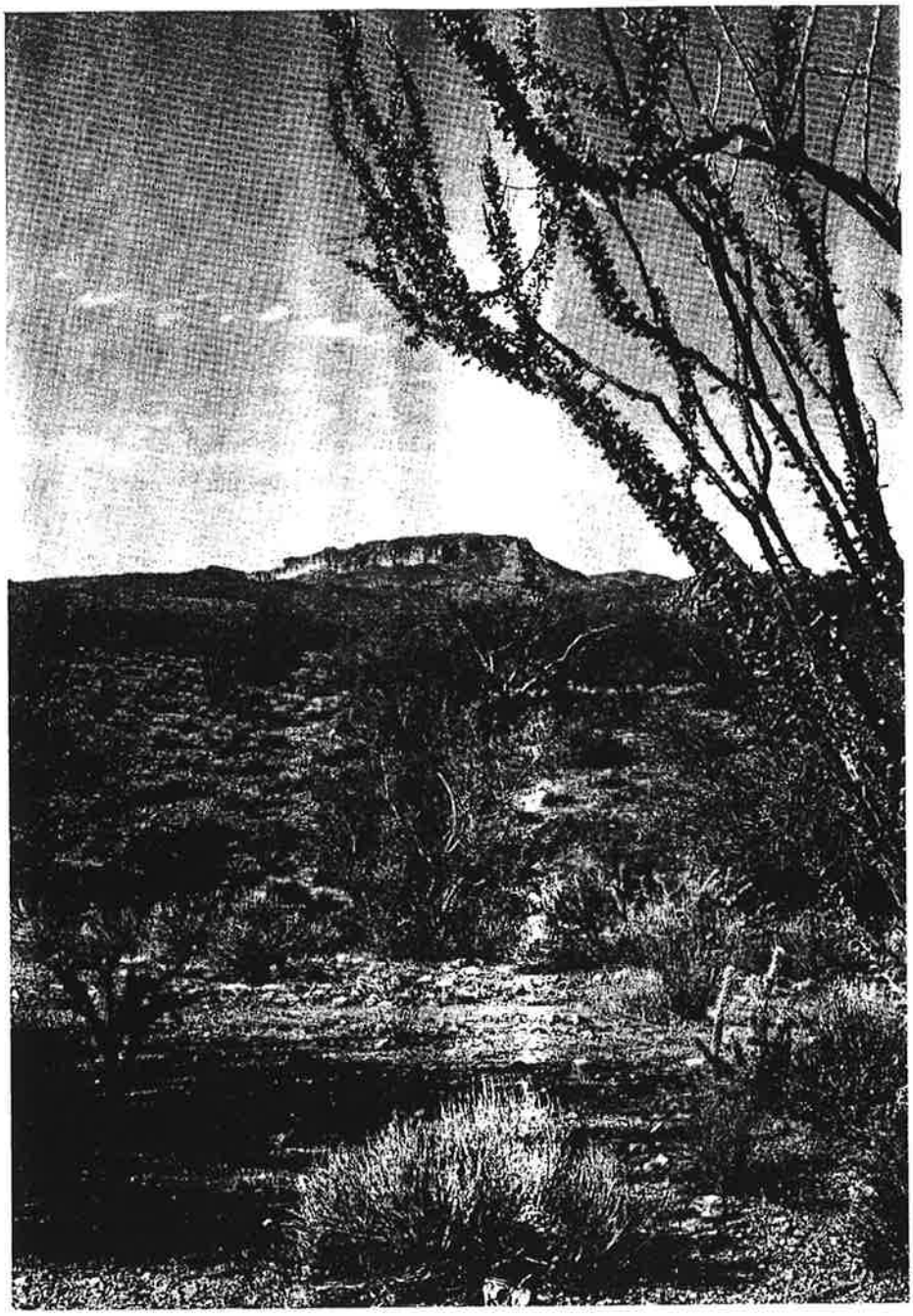

Figure 7. Habitat of *Lichanura t. gracia* in the northern Sonoran Desert of Arizona (Area F). Photo by author.

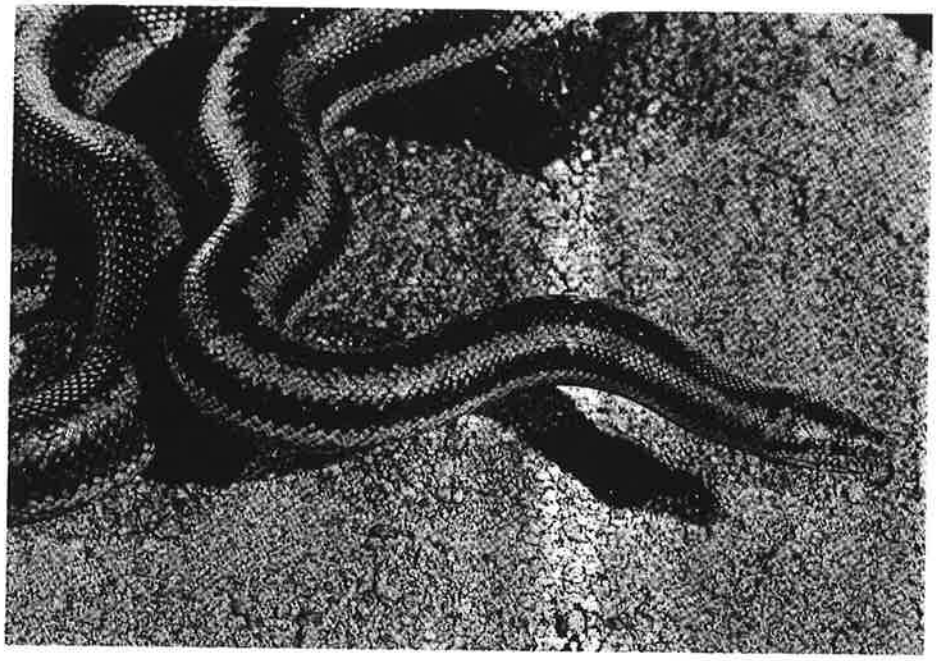

Figure 8. Adult female *Lichanura t. gracia* from the Kofa Mountains, Yuma County, Arizona (Area F). Photo by author.

TABLE 2. Results of MANOVA. The (*) indicates a variable whose variance is not significantly different among the ten areas (P>.05).

VARIABLE	F-RATIO	F PROBABILITY
VENTRL	28.82	0.000
CAUDAL	1.98	*0.085
ANTBOD	8.26	0.000
MIDBOD	2.53	0.032
POSBOD	1.81	*0.115
SUPLAB	7.41	0.000
INFLAB	4.05	0.002
OCULAR	9.27	0.000
INFROC	8.94	0.000
STR WD	13.74	0.000
PREOCU	0.22	*0.952

(CA2). Area H does not overlap any other area over its 95% confidence limit range indicating that DA was able to discriminate between Area H and the other areas. The first canonical axis was instrumental in isolating Area H by the higher number of oculars and the lower number of ventrals (Fig. 13). The second canonical axis was not instrumental in the isolation of Area H. Areas B,C,D,E and F overlap each other at some point in their 95% confidence limits indicating close association between the five areas.

This study shows that the *Lichanura trivirgata* of Area H are not *L. t. gracia*, supported by the evenness of the dorsal stripe, lower number of ventrals, higher number of oculars, and geographic isolation. This population has not been previously identified and is formally identified in this study as the following.

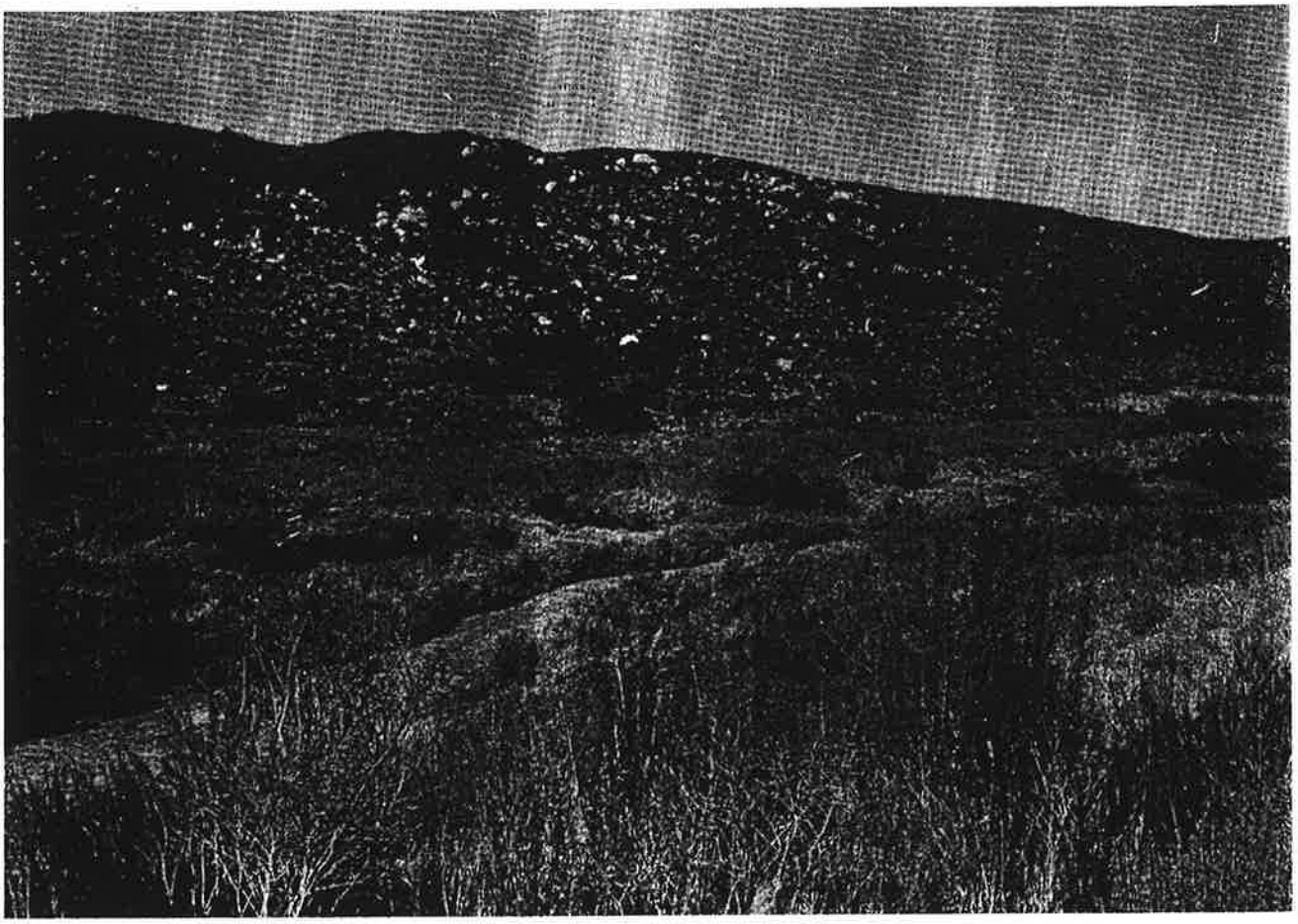

Figure 9. Habitat of *Lichanura t. roseofusca* north of San Quintin, Baja California Norte, Mexico (Area G). Photo by author.

TABLE 3. Coefficients for the Canonical Vectors (CV) 1 and 2. The numbers in the parenthesis are the percent of variance of each variable contributed to each CV. The (*) indicates variables with greatest affect on each CV.

Canonical Vector (CV)	1	2
VENTRL	*-0.906 (93.70)	0.155 (0.57)
ANTBOD	-0.287 (63.79)	0.316 (16.02)
MIDBOD	0.074 (3.87)	*-0.690 (69.94)
SUPLAB	0.097 (9.23)	* 0.565 (65.06)
INFLAB	-0.153 (41.28)	-0.255 (23.60)
OCULAR	* 0.240 (90.68)	-0.048 (0.75)
INFROC	-0.016 (23.90)	0.061 (72.20)
STR WD	-0.031 (29.95)	-0.096 (59.53)

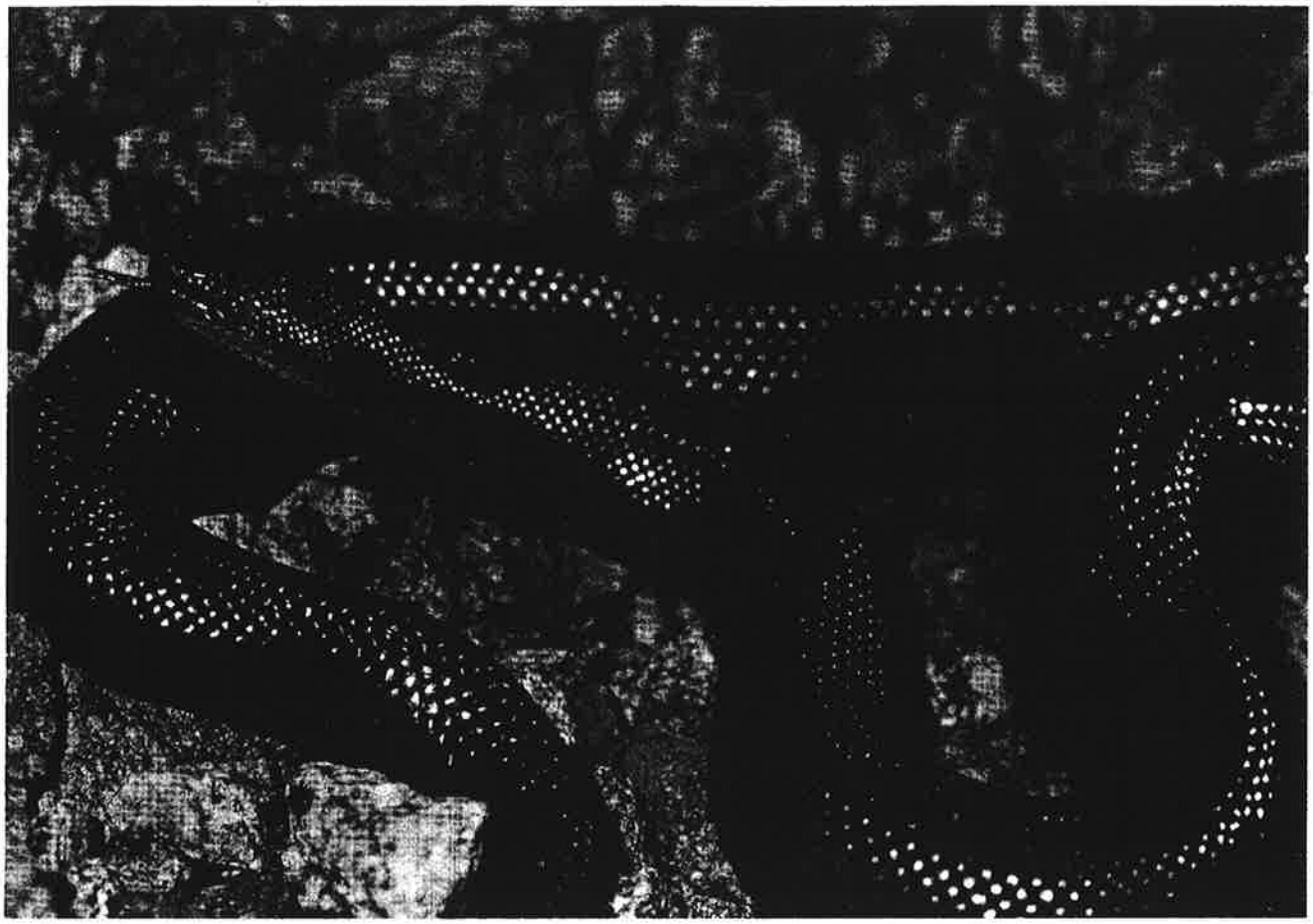

Figure 10. Adult female *Lichanura t. roseofusca* from the vicinity of Ensenada, Baja California Norte, Mexico (Area G). Photo by author.

Lichanura trivirgata saslowi
subsp. nov.
The Mid-Baja Boa (Fig.14)

Type. - SDSNH 42443 collected near Bahia de los Angeles, Baja California Norte, Mexico.

Diagnosis. - A subspecies of *Lichanura trivirgata* differing from the nominal species in having three very even to evenly serrated stripes approximating Smithe's (1975) Color 32, Chestnut, and may be outlined in black. The interspace approximates Color 79 or 80, Glaucous. The ventrals approximate Color 44, Smoke Gray; the color extends to the dorsolateral stripe. The young are born with ventrals which are unmarked and may become spotted, barred, or mottled with age. Specimens from the vicinity of San Felipe, BCN, appear to retain unmarked ventrals. The color of the eyes of specimens from the vicinity of Bahia de los Angeles, BCN, is brilliant and resembles the dorsal stripe.

L. t. saslowi differs from *L. t. roseofusca*, *L. t. gracia*, and *L. t. trivirgata* by means of the ventral, ocular, and infraocular scale counts (Spiteri, 1987). Bilaterally symmetrical scales are added together. The ventrals range from 215-234 with a mean of 226.05. The oculars range from 17 to 23 with a mean of 20.80. The infraoculars range from 0 to 2 with a

Figure 11. Habitat of *Lichanura t. saslowi* in the vicinity of Catavina, Baja California Norte, Mexico (Area H). Photo by author.

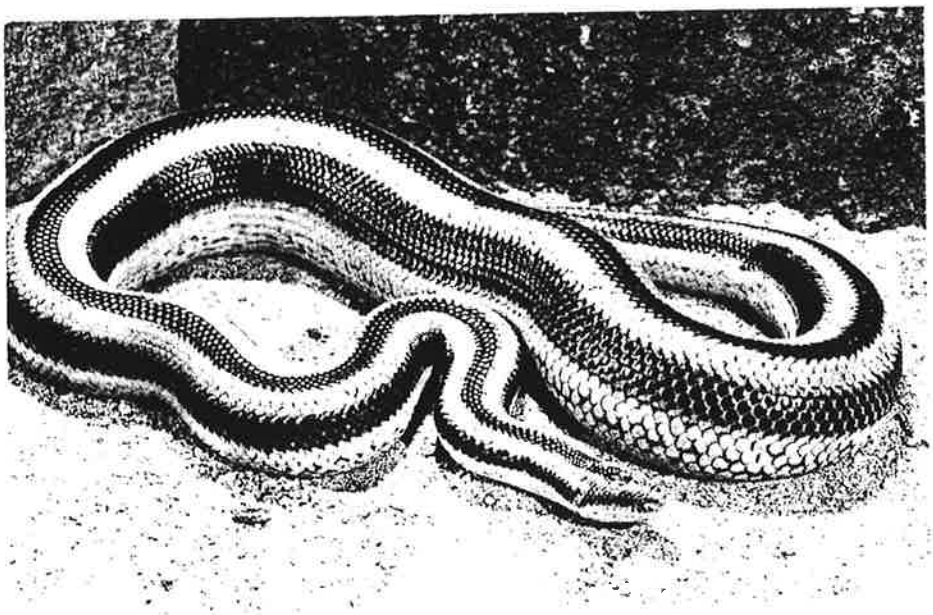

Figure 12. Adult female *Lichanura t. trivirgata* from the vicinity of La Paz, Baja California Sur, Mexico (Area I). Photo by author.

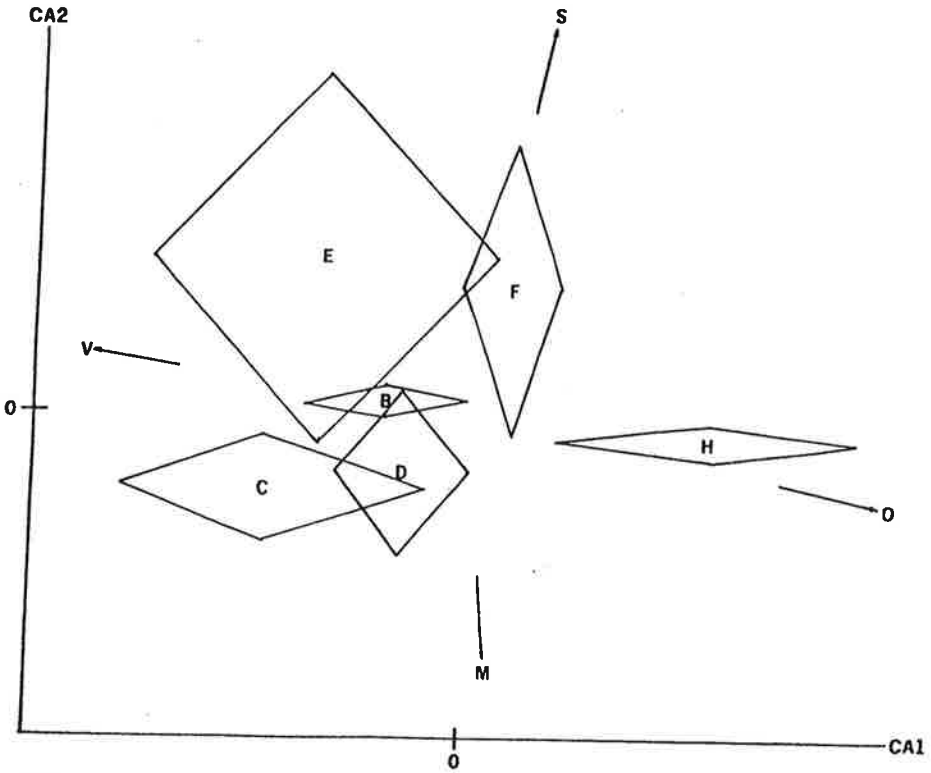

Figure 13. Scatterplot of the centroids for canonical axis 1 (CA1) and canonical axis 2 (CA2). The letters B,C,D,E,F and H correspond to the centroid location of the respective geographic areas of this study. The area enclosed around each centroid represents their respective 95% confidence limits. The vectors indicate the direction of increase in the discriminating variables (from Table 3). V=ventrals, O=oculars, S=supralabials, M=mid body scale rows.

mean of 0.90.

Description of Holotype. - A female, 60.5 cm snout to vent length with a 9.6 cm tail. Ventrals 221. Subcaudals 48. Supralabials 14 and 14. Infralabials 16 and 15. Oculars 10 and 10. Infraoculars 0 and 1. The dorsal stripe is evenly serrated and is four scales wide. There are 10 scale rows from the ventrals to the dorsolateral stripes. The interspace between stripes is 4 scales wide. The ventrum is spotted. The body scale row counts are 35 at the anterior, 40 at mid-body, and 26 posteriorly. The loreals are 3 on each side with 2 and 3 subloreals. It has 4 interoculars.

Remarks. - This subspecies has been called *L. t. gracia* by previous authors. The only common characteristic that this subspecies shares with Klauber's description of *L. r. gracia* is the evenness of the dorsal stripe. The means for the ventrals, oculars, and infraoculars statistically differ from *L. t. gracia* as shown by t-test and MANOVA (Spiteri, 1987) and discriminant analysis (this study). Colors, patterns, and biogeographic range are also different. Klauber had a specimen from six miles south of El Socorro, BCN, (SDSNH 15511). But this specimen conflicted to such an extent with his description of *L. t. gracia* that he

admittedly did not include this snake in his statistics and description of *L. t. gracia* (Klauber, 1931).

Etymology. - The subspecies is named after biologist Dr. Herbert Basil Saslow who at one time in his diverse career taught human genetics at the University of Rochester and at the University of Vienna. His major interests were the reproductive physiology, endocrinology, and comparative anatomy of the mosquito fish, *Gambusia*. I met Dr. Saslow when I was a youngster. From that time until the present, he has stimulated and encouraged my interest in herpetology. Dr. Saslow is currently retired in Florida.

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