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Author: Charles J. Cole

Author: Laurence M. Hardy

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Transcriber's Notes

The scale of Figure 4 and Figure 5 are preserved from the original, if viewed on a 96 DPI monitor screen and with a browser setting of 100%.

The only changes made to the text are the following:

Page 623 Table 3 column heading: changed "or" to "of" (Number of specimens).

Page 625: changed "percent" to "per cent" (92 per cent of the time).

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Morphological Variation in a Population of the Snake, Tantilla gracilis Baird and Girard

[Pg 615]

By

LAURENCE M. HARDY AND CHARLES J. COLE

INTRODUCTION

Variation of selected taxonomic characteristics of flat-headed snakes (*Tantilla gracilis* Baird and Girard) from several midwestern states was studied by Force (1935), but she did not attempt a comprehensive evaluation. Taylor (1936) reported on variation in *T. gracilis* from various localities in Kansas; Kirn, Burger, and Smith (1949) studied selected structures of specimens of *T. gracilis* from throughout its range. The present study was undertaken to determine the variation in both currently used and potential taxonomic characteristics of *T. gracilis* from one locality.

We are thankful to Charles W. Myers, Gorgas Memorial Laboratory, for suggestions concerning characteristics examined. We are indebted to Drs. William G. Degenhardt, University of New Mexico, Herndon G. Dowling, New York Zoological Society, Charles H. Lowe, University of Arizona, and Richard G. Zweifel, American Museum of Natural History, for criticizing the manuscript. Dr. William E. Duellman permitted us to study specimens in the University of Kansas Museum of Natural History.

Materials and Methods

The specimens examined were donated to the Museum of Natural History, University of Kansas, by the late Paul Anderson of Independence, Missouri. All specimens (KU numbers 83435-83680; N = 246) were collected in the vicinity of Winfield, Cowley County, Kansas, by Charles E. Burt and students from Southwestern College in the period from 1938 to 1941, inclusive.

Both authors gathered data on most characteristics and examined each atypical individual. Hardy determined characters of the maxillae (which were removed; N = 20), body and total lengths, and the scale formula of KU 83620.

We examined 22 characteristics of external morphology and 10 of the maxillae. All paired characteristics (excepting those of the maxillae) were examined on both sides of each snake and are referred to from the left side to the right side (for example, "preoculars 1-2" means there is one preocular on the left side and there are two on the right). Oviducts and oviducal eggs were observed on specimens designated as females; hemipenes were examined on specimens designated as males. Total length was measured by straightening each snake along a 300 mm. scale. Tail length was measured only on snakes having complete tails, and body length (snout-vent) was considered as total length minus tail length. The body length was measured on snakes having incomplete tails. [Pg 616]

Supralabials, infralabials, preoculars and postoculars were counted, and we followed Peters (1960:9) in determining the nature of the temporals. Occasionally the primary (anterior) temporal is separated from the postocular by contact of the parietal and a supralabial (Taylor, 1936:338). We followed Peters (1964:219-220) in determining characteristics of the nasal and we looked for contact of the prefrontal with particular supralabials (Taylor, 1936:338). We determined which

supralabials are in contact with the eye and whether the mental is in contact with the anterior pair of chin-shields.

The number of rows of dorsal scales was determined at five locations: a) around the neck—counts were made from each side diagonally and posteriorly from the anteriormost dorsal scale in contact with the first ventral (see below)—counts from the left and right sides are the first and second counts, respectively, recorded in the scale formula; b) one head length posterior to head—counts were made either diagonally and posteriorly or in a zig-zag pattern, beginning at the end of the second count around the neck—this is the third count recorded in the scale formula; c) midbody (approximated)—counts were made either diagonally and posteriorly or in a zig-zag pattern—this is the fourth count in the scale formula; d) anterior to anus (preanal)—counts were made in a zig-zag pattern beginning on one side and ending on the other at the first dorsal scale in contact with the anal plate—this is the fifth count in the scale formula.

We followed the method of Dowling (1951:98-99) in counting ventrals, and the anal plate was determined as entire, divided, or partly divided. Subcaudals were counted on only the right side beginning at the first scale that contacts a corresponding scale from the opposite side; fusion of particular pairs of subcaudals was determined. The "spine" at the tip of the tail was not counted. The head scutellation of each specimen was examined for abnormalities.

We determined the number of fangs and the number of maxillary teeth anterior to them and recorded the presence or absence of a diastema between the anterior fang and the maxillary tooth immediately preceding it. The diastema, if present, is a space distinctly wider than the spaces separating the prediastemal teeth.

The point of intersection of two perpendicular lines of an ocular grid determined which tooth-socket occurs directly opposite the distal tip of the suborbital process (Fig. 5b), but if that point occurs between two sockets then the number recorded was the number of the tooth immediately anterior to that point plus one-half.

The anterior and posterior edges of the suborbital process were determined as parallel or not at any point by aligning them with parallel lines on an ocular grid (Fig. 5b).

The angle of the posterior edge of the lateral flange was determined as an acute, obtuse, or right angle by fitting it to a pair of perpendicular lines of an ocular grid (Fig. 5b).

The number of lateral anterior foramina (Fig. 4b) was determined. If only two are present, their lengths (anterior to posterior) were compared by measuring them with an ocular micrometer. Also, if two lateral anterior foramina are present, the point of intersection of two perpendicular lines of an ocular grid determined which tooth-socket occurs directly below the center of the posterior foramen (Fig. 4b). [Pg 617]

RESULTS

General Characteristics

From the data given by Force (1935), Taylor (1936), and Kirn *et al.* (1949), and from our own data, we conclude that a typical specimen of *gracilis*, meaning a specimen having the usual characteristics of the species, has the following characteristics in combination: supralabials 6-6; infralabials 6-6; preoculars 1-1; postoculars 1-1; temporals 1 + 1 on each side; nasal divided below naris; supralabials 3 + 4 entering orbit; mental in contact with chin-shields; all five dorsal scale counts 15; and plate divided. (In the present work we use the words usual, unusual, typical, and atypical with neither quotation marks nor apology).

Of the 244 specimens on which we could examine each of these characteristics, only 125 (51.2%) have all of the typical characteristics in combination. The 119 specimens that do not possess all of the typical characteristics in combination include 31 (12.7% of the 244) that lack at least two of the typical characteristics.

Sex

The sample (N = 246) is composed of 107 (43.5%) females and 139 (56.5%) males.

Measurements

Females have total lengths from 96 to 244 mm. (mean, 173.3; N = 79). One female (KU 83480) measuring 244 mm. may be the longest specimen known (Conant, 1958, reports the longest as 9-1/8 inches—approximately 232 mm.). Males have total lengths from 96 to 215 mm. (mean, 162.4; N = 109). Females have tail lengths from 16 to 50 mm. (mean, 34.6; N = 79), and males have tail lengths from 21 to 53 mm. (mean, 37.8; N = 109).

The ratio of tail length to total length in females is from 0.17 to 0.22 (mean, 0.20; N = 79); in males it is from 0.21 to 0.27 (mean, 0.23; N = 109; Fig. 1). Juveniles (those less than 125 mm. in total length according to Force, 1935: tables 1

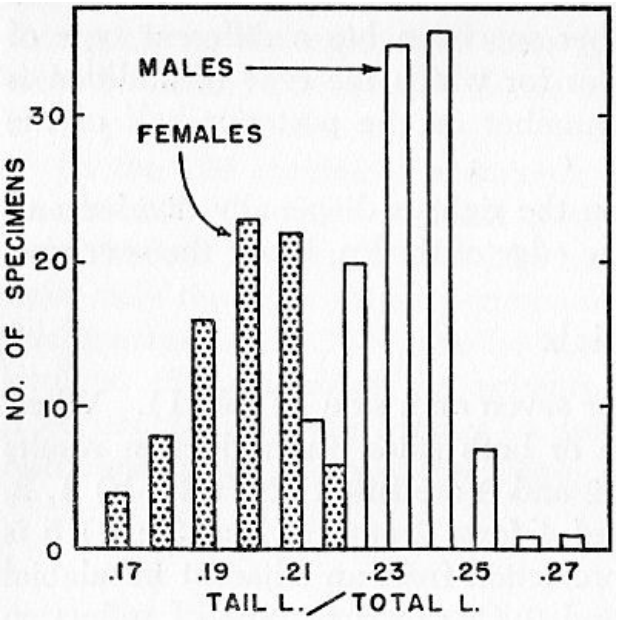

Fig. 1. Ratio of tail length to total length in females and males of *T. gracilis*.

and 2) have proportionally shorter tails than do adults; the ratio of tail length divided by total length is 0.17-0.21 (mean, 0.18; N = 14) in females and 0.21-0.23 (mean, 0.22; N = 16) in males. Adult females (125 mm. or more in total length) have ratios from 0.18 to 0.22 (mean, 0.20; N = 65) and adult males have ratios from 0.21 to 0.27 (mean, 0.23; N = 93).

Of the 246 specimens examined, 58 have incomplete tails. Of these 58 specimens, six had freshly broken tails, so we assume that 52 (21.1% of the 246) have incomplete tails resulting from natural causes; the remaining six specimens could have had their tails broken at or soon after capture, assuming that none of the snakes was retained in captivity for an extended period. [Pg 618]

Supralabials

The supralabials are either six (usually) or seven on a side (Table 1). When seven supralabials are present on either one or both sides, the addition results from one of the following conditions: a) 5 is divided to form 5 and 6 (N = 6); b) 2 and 3 form 2, 3, and 4 (N = 1); c) 5 and 6 form 5, 6, and 7 (N = 12); d) 4, 5, and 6 form 4, 5, 6, and 7 (N = 1); e) 1 and 2 form 1, 2, and 3 (N = 1); f) 1, 2, and 3 form 1, 2, 3, and 4 (N = 1); g) 2 is fused with the nasal, and 3 and 4 are reduced to granules (N = 1); h) type of addition unknown (N = 5).

TABLE 1. Variation in Number of Supralabials (N = 245) and Infralabials (N = 246) of Tantilla gracilis.

Number of Supralabials	Number of specimens	Per cent of occurrence	Number of infralabials	Number of specimens	Per cent of occurrence
6-6	221	90.2	5-5	5	2.0
6-7	10	4.1	5-6	4	1.6
7-6	10	4.1	6-5	5	2.0
7-7	4	1.6	6-6	229	93.1
			6-7	1	0.4
			7-6	2	0.8

In three of the four specimens with 7-7 supralabials, the type of addition is the same on each side, whereas the other specimen has a different type of addition on each side. Of the 23 examples for which the type of addition is known, 19 (82.6%) have the increase in number on the posterior half of the series.

In one specimen the third supralabial on the right is diagonally divided and the resulting upper part does not contact the edge of the lip; hence the specimen has 6-6 supralabials.

Infralabials

The infralabials are five, six (usually), or seven on a side (Table 1). When five infralabials are present on either one or both sides, the reduction results from one of the following conditions: a) 2 and 3 are fused (N = 3); b) 1, 2, and 3 form 1 and 2 (N = 6); c) 2, 3, and 4 form 2 and 3 (N = 3); d) 5 is separated from the edge of the lip by a projection from an adjacent infralabial (N = 1); e) 1, 2, 3, and 4 form 1, 2, and 3 (N = 2); f) type of reduction unknown (N = 4).

Of the specimens with 5-5 infralabials, two have the same type of reduction on each side, one has a different type of reduction on each side, and the type of reduction is unknown for the other two specimens.

When seven infralabials are present on either one or both sides, the addition can result from infralabials 2 and 3 forming 2, 3, and 4 (N = 2); the type of addition is unknown in one specimen. [Pg 619]

In one specimen the second infralabial on the right side is reduced to a small wedge-shaped granule and in another specimen several infralabials on both sides are irregularly divided horizontally, although both specimens have six infralabials on the sides having the abnormalities.

Preoculars

Of the 245 specimens examined, 242 (98.8%) have one preocular on each side. Both preoculars

are absent from two specimens, and one specimen has 1-0. In each case when a preocular is lacking, the "preocular" and prefrontal are fused. One specimen having 1-1 preoculars has both of them reduced to small vertical slivers.

Postoculars

Of the 245 specimens examined, 242 (98.8%) have one postocular on each side. Postoculars are 2-1 in two specimens and 1-2 in one. In one specimen the lower of the two postoculars on each side is very small, being approximately 1/6 the diameter of the upper one (measured with an ocular micrometer).

Temporals

Of the 245 specimens examined, 235 (95.9%) have 1 + 1 temporals on each side. Four specimens exhibit addition of temporals: one specimen has two secondary temporals on the left, and one has a tertiary temporal on the left. Two specimens have partly healed head injuries that probably caused atypical temporal conditions: one specimen has two primary temporals on the left, and one has two secondary temporals on the left and two upper and one lower secondary temporal on the right.

Six specimens exhibit reduction of temporals: one lacks a primary temporal on the left ("temporal" is fused with sixth supralabial), two lack secondary temporals on the right, and three lack secondary temporals on the left. The right secondary "temporal" of one specimen is separated from the supralabials by a posterior extension of the primary temporal.

Of the 246 specimens examined, 200 (81.3%) have both primary temporals in contact with their adjacent postoculars. Thirteen specimens (5.3%) have only the left primary temporal in contact with the postocular and eight (3.3%) have only the right primary temporal in contact with the postocular. Twenty-five specimens (10.2%) have both primary temporals separated from the postoculars. Separation of the primary temporal from the postocular, whenever it occurs, results from contact of mutual extensions from the adjacent parietal and supralabial (usually the fifth).

Nasal

Of the 243 specimens examined, 237 (97.5%) have the nasal divided below the naris on both sides. Three specimens have the nasal completely divided (above and below the naris) on only the left side; one specimen has a completely divided nasal on only the right side. A groove, but not a complete division of the nasal, is present above the left naris of one specimen. One specimen lacks the typical division below the naris on both sides, but a complete suture is present posterior to the naris and the resulting postnasal scales are, according to position, loreals. [Pg 620]

Contact of prefrontal with supralabials

Of the 243 specimens examined, 147 (60.5%) have the prefrontal separated from the labials on each side. Of the remaining 96 specimens, 53 (21.8% of the 243) have the prefrontals in contact with the second labial on each side; five other variations of this characteristic were observed (Table 2).

TABLE 2. Variation in Contact of the Prefrontals and the Labials in 243 Specimens of Tantilla gracilis.

CHARACTERISTIC	Number of specimens	Per cent of occurrence
No contact	147	60.5
Contact of prefrontal with second labial on right	26	10.7
Contact of prefrontal with second labial on left	10	4.1
Contact of prefrontal with each second labial	53	21.8
Contact of prefrontals with labial two on left and labial three on right	1	0.4
Contact of prefrontals with labial three on left and labial two on right	3	1.2
Contact of prefrontals with labial two on left and labials two and three on right	3	1.2

The specimen having the prefrontal in contact with labial 2 on the left and labial 3 on the right has seven supralabials on the right, the extra labial being added anterior to the eye. In two of the three specimens with the prefrontals in contact with labial 3 on the left and labial 2 on the right, the preoculars and prefrontals are fused on each side; the third specimen has each preocular reduced to a small vertical sliver. Of the three specimens having the prefrontals in contact with labial 2 on the left and labials 2 and 3 on the right, two are typical with respect to other characteristics that might result in this atypical condition, but one has the prefrontals and preoculars fused.

Supralabials entering orbit

Of the 246 specimens examined, 233 (94.7%) have the third and fourth supralabials entering each eye (Table 3). All snakes that have the fourth and fifth labials entering the orbit on either side also have seven supralabials on the same side. One specimen having only the fourth labial entering the eye on the right side also has six supralabials on that side, but the third supralabial is split diagonally and the part contacting the eye does not contact the lip and hence is not a supralabial. The remaining three atypical conditions (4/3 + 4; 3 + 4/3 + 4 + 5; 3 + 4 + 5/3 + 4) occur only one time each and on snakes having 6-6 supralabials.

Contact of mental with chin-shields

Of the 246 specimens examined, 190 (77.2%) have the mental in contact with both anterior chin-shields. The mental is in contact with only the left anterior chin-shield in 15 specimens, only the right anterior chin-shield in 2 specimens, and the mental does not contact either anterior chin-shield in 39 specimens. Separation of the mental and an anterior chin-shield always results from the posterior elongation of a first infralabial. [Pg 621]

Table 3. Variation in Number of Supralabials Entering the Eye in 246 Specimens of Tantilla gracilis.

Supralabials		Number of specimens	Per cent of occurrence
Left	Right		
3 + 4	3 + 4	233	94.7
4 + 5	3 + 4	4	1.6
4	3 + 4	1	0.4
3 + 4	4 + 5	5	2.0
3 + 4	4	1	0.4
3 + 4	3 + 4 + 5	1	0.4
3 + 4 + 5	3 + 4	1	0.4

Dorsal scale rows

Of the 245 specimens examined for this characteristic, 228 (92.7%) have scale counts of 15-15-15-15-15. The number of scale rows around the neck and one head length behind the head are 15 except in a single specimen that has 14 scale rows at these three places. The number of scale rows around midbody is 15 in 244 of 246 specimens (99.2%); two specimens have 14 scale rows around midbody. The number of preanal scale rows is more variable; counts of 14 through 17 were recorded. Fourteen specimens have 14 preanal scale rows (5.7%), 229 have 15 preanal rows (93.1%), two have 16 preanal rows (0.8%), and one has 17 preanal rows (0.4%). Known causes for atypical numbers of preanal scale rows are listed in Table 4. A preanal count at one head length anterior to the anus would have omitted most of the above variation in numbers of preanal scale rows.

Table 4. Atypical Numbers of Preanal Scale Rows in Specimens of Tantilla gracilis.

Preanal scales	Number of specimens	Cause	Per cent of occurrence
14	10	Scale rows seven and eight on left fuse within the last five ventrals	4.1
14	1	Scale row two on the right is lost adjacent to the penultimate ventral	0.4
16	1	Scale row eight on the left divides adjacent to the last ventral	0.4
16	1	A scale row is added on the right adjacent to and anterior to the anal plate	0.4
17	1	A scale row is added on each side adjacent to and anterior to the anal plate	0.4

The complete dorsal scale formula for KU 83620, a male, is as follows: [Pg 622]

$$15\ \frac{6+7(2)}{6+7(2)}\ 13\ \frac{+7(4)}{}\ 14\ \frac{}{+7(5)}\ 15\ \frac{6+7(11)}{6+7(11)}\ 13\ \frac{}{6=6+7(17)},$$

$$14\ \frac{}{6+7(18)}\ 13\ \frac{}{+7(25)},$$

$$14\ \frac{+7(26)}{}\ 15\ \frac{}{6+7(36)}\ 14\ \frac{6+7(38)}{}\ 13\ \frac{+7(39)}{}\ 14\ \frac{}{+7(42)},$$

$$15\ \frac{}{-6(45)}\ 14\ \frac{}{+7(53)},$$

$$15\ \frac{7+8(67)}{}\ 14\ \frac{+7(69)}{}\ 15\ \frac{}{6+7(90)}\ 14\ \frac{}{+7(93)}\ 15\ \frac{}{6+7(99)},$$

$$14\ \frac{}{+7(100)}\ 15(122).$$

[Textual representation of dorsal scale formula.]

Specimen 83620 is the only one for which we have determined the complete dorsal scale formula. Obviously the formula is complex, and possibly the specimen is atypical in this regard. Nevertheless, addition and reduction of scale rows is apparent on other specimens and can be easily observed by examining specimens under a dissection microscope.

Anal plate

Of the 246 specimens examined, 232 (94.3%) have the anal plate divided. Of the 14 specimens having undivided anal plates, four have an incomplete groove anteriorly in the plate.

Ventrals

Females have from 122 to 137 (mean, 130.8 ± 0.26; N = 107) ventrals; males have from 117 to 131 (mean, 122.3 ± 0.21; N = 139; Fig. 2). Of the 246 specimens examined, 29 (11.8%; 11 females and 18 males) have an added half-ventral immediately anterior to the anal plate. Of these [Pg 623] specimens, 27 have the added half-ventral on the left side and two have it on the right. Five specimens have the last ventral divided similar to the normal division of the anal plate. One specimen has the last ventral incompletely divided transversely. Excluding the last ventral, seven specimens have divided ventrals (half-ventrals). Four of these specimens have added half-ventrals on the right side (two specimens with one half-ventral each, one specimen with two half-ventrals, and one specimen with three half-ventrals), and four have added half-ventrals on the left side (one half-ventral on each specimen).

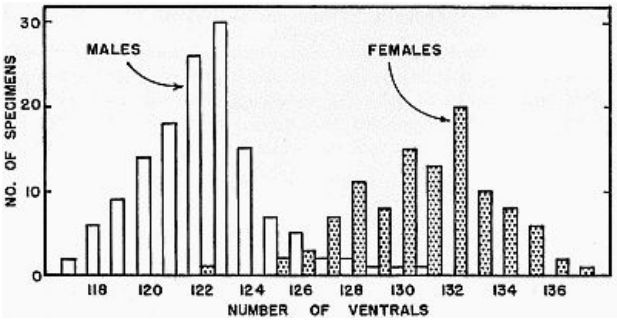

Fig. 2. Number of ventrals in females and males of T. gracilis.

Subcaudals

Females have from 37 to 47 (mean, 42.0 ± 0.20; N = 79) subcaudals; males have from 43 to 55 (mean, 48.4 ± 0.23; N = 109; Fig. 3). Of the 187 specimens examined, 13 (7.0%) have the last pair of subcaudals fused. One specimen has left subcaudal 28 fused with both adjacent subcaudals (also fused) on the right. While reading proof we found two omissions in Fig. 3; there should be illustrated two males with 43 subcaudals and three males with 44 subcaudals.

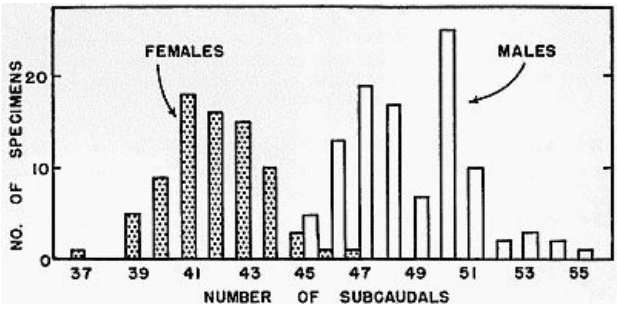

Fig. 3. Number of subcaudals in females and males of *T. gracilis*.

Ventrals minus subcaudals

The value for number of ventrals minus the number of subcaudals varies from 80 to 96 (mean, 88.8 ± 0.39) for 79 females, and from 67 to 83 (mean, 73.8 ± 0.28) for 109 males.

Additional scale characteristics

Of the 246 specimens examined, four (1.6%) have the rostral in contact with the left prefrontal, and hence the internasals are separated from one another. One snake has approximately one-fourth (anteriorly) of the suture between the parietals fused. One specimen has the posterior edge of the frontal fused with the left parietal. One specimen has the parietal shield on the right side abbreviated posteriorly. One specimen has both prefrontals fused with the frontal, although an incomplete suture is present. [Pg 624]

Maxillary characteristics (*Figs. 4 and 5*)

Maxillary teeth anterior to fangs 10-14 (mean, 12.1; N = 20); tooth-socket number 6.5-8.5 (mean, 7.2; N = 20) directly opposite distal tip of suborbital process; lateral anterior foramina 1-3 (mean, 1.8; N = 20); tooth number 6-9 (mean, 6.9; N = 12) directly below center of posterior foramen (if only two foramina present). Three specimens lack a diastema and 17 specimens have a diastema. The anterior and posterior edges of the suborbital process are parallel in two specimens and not parallel in 14; the process is broken in four specimens. The lengths (anterior to posterior) of the lateral anterior foramina (if only two are present) are approximately equal in six specimens, and in six the anteriormost one is the longest; six specimens have one foramen and two specimens have three foramina. All specimens examined have two fangs, with the posterior edge of the lateral flange forming an obtuse angle.

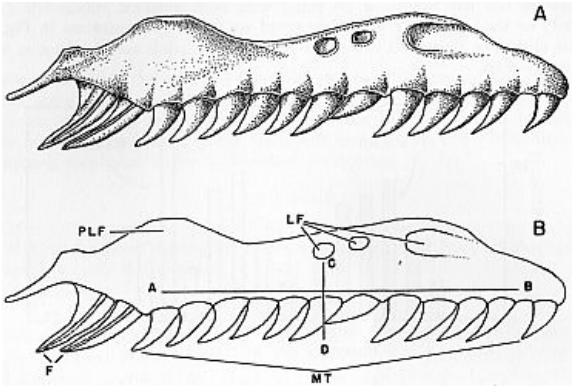

Fig. 4. Lateral view of right maxilla of *T. gracilis* (KU 83484), × 39. Actual length of bone is 2.44 mm. A. Detail of bone. B. Outline sketch of bone to illustrate characteristics examined. Lateral anterior foramina (LF); fangs (F); "prediastemal" maxillary teeth (MT); lateral flange (PLF); perpendicular lines, A-B and C-D, are used to determine which tooth-socket occurs directly below the center of the posterior foramen (the specimen illustrated is atypical because there are three foramina present).

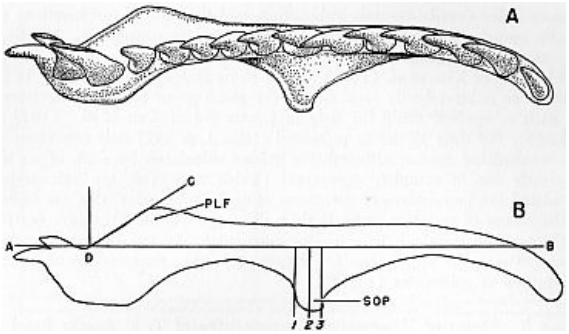

Fig. 5. Ventral view of right maxilla of *T. gracilis* (KU 83484), × 39. Actual length of bone is 2.44 mm. A. Detail of bone. B. Outline sketch of bone to illustrate characteristics examined. Lateral flange (PLF) forms an obtuse angle (ADC) with main axis of bone (AB); a reference line (2), perpendicular to the main axis of the bone, is used to locate the tooth-socket directly opposite the tip of the suborbital process (SOP); the anterior and posterior edges of the suborbital process are not parallel at any point (reference lines 1 and 3).

Discussion and Conclusions

Generic characteristics of *Tantilla* are as follows: size small, body slender, head not noticeably distinct from body; preoculars one; postoculars one or two; nasals two; loreal absent; smooth dorsal scales in 15 rows; anal plate usually divided but sometimes single; subcaudals paired; usually two enlarged, posterior, grooved fangs on the maxilla separated by a small diastema from the other maxillary teeth (Baird and Girard, 1853:131; Cope, 1900:1110; Dunn, 1928:24; Blanchard, 1938:369; Schmidt and Davis, 1941:268; Wright and Wright, 1957:722; Conant, 1958:180). Of these characteristics, only the following were invariable in our sample: size small, [Pg 625] body slender, head not noticeably distinct from body; postoculars one or two; smooth dorsal scales; posterior grooved fangs on maxilla. The dorsal scales, anal, and subcaudals were "correct" 92 per cent of the time; the preoculars and nasals were "correct" 97 per cent of the time.

Tantilla reportedly has two nasals (Baird and Girard, 1853:131; Cope, 1900:1110; Wright and Wright, 1957:722). *Tantilla gracilis* usually has a single nasal that is divided below the naris; variation in this characteristic is discussed above.

In addition to the generic characteristics, specific characteristics for *T. gracilis* are as follows: supralabials 5-8 (usually 6); supralabials 3 and 4 entering orbit; infralabials 5-7 (usually 6); temporals 1 + 1; ventrals 115-138 in females, 106-132 in males; subcaudals 33-53 in females, 40-57 in males; tail length 13-27 per cent total length in females, 15-30 per cent in males (Baird and Girard, 1853:132; Cope, 1900:1111-12; Force, 1935:653-54; Taylor, 1936:337-38; Blanchard, 1938:371-72; Kirn, Burger, and Smith, 1949:240-49). Excepting the number of temporals and the supralabials entering the orbit, the characteristics of the specimens in our sample are within the ranges of variation mentioned above. Of the 10 maxillary characteristics studied, no variation was observed in number of fangs or angle of lateral flange.

Because our data have some bearing on the problem of geographic variation in *T. gracilis* and the recognition of subspecies, we comment briefly on the status of subspecies in *T. gracilis*. Kirn, Burger and Smith (1949) proposed the recognition of two subspecies of *Tantilla gracilis* (*T. g. gracilis* Baird and Girard and *T. g. hallowelli* Cope). These subspecies were diagnosed on the [Pg 626] basis of differences in ventrals, subcaudals, and the ratio of tail length to total length; sexual dimorphism in each characteristic was considered. We do not recognize these subspecies for the reasons given below.

The data of Kirn *et al.* (1949) appear to be presented inaccurately in part. Both of us independently recalculated the mean given for each characteristic for each subspecies, using the data in figures 2-4 of Kirn *et al.* (1949:242, 244-245). Of their 12 means presented (table 1, p. 247) only two agree with our recalculated means, although the means calculated by each of us independently are in complete agreement (Table 5). Also, we independently calculated the percentages of specimens of each "subspecies" that are included in the ranges of variation given in their diagnoses (Table 5); again, our independent calculations are in complete agreement. In our opinion the differences between the populations for the characteristics analyzed do not warrant recognition of subspecies (Fig. 6).

TABLE 5. Means of "Diagnostic" Characteristics of T. g. gracilis Baird and Girard and T. g.

hallowelli Cope.

Characteristics	*T. g. gracilis*			*T. g. hallowelli*		
	Mean (Kirn, *et al.* 1949)	**Mean (Kirn, *et al.*) recalculated by us**	**Per cent specimens of Kirn, *et al.* included their diagnosis**	**Mean (Kirn, *et al.* in 1949)**	**Mean (Kirn, *et al.*) recalculated by us**	**Per cent specimens of Kirn, *et al.* included in their diagnosis**
Ventrals—females	125.67	125.71	69.4	130.07	130.07	79.6
Ventrals—males	115.97	116.61	70.0	121.22	120.87	69.7
Caudals—females	40.99	40.82	62.8	46.79	43.82	77.4
Caudals—males	47.75	48.29	78.3	51.67	50.29	51.0
Tail L./total L. females	.1976	.1976	69.0	.2084	.2076	74.2
Tail L./total L. males	.2336	.2362	56.1	.2477	.2423	79.6

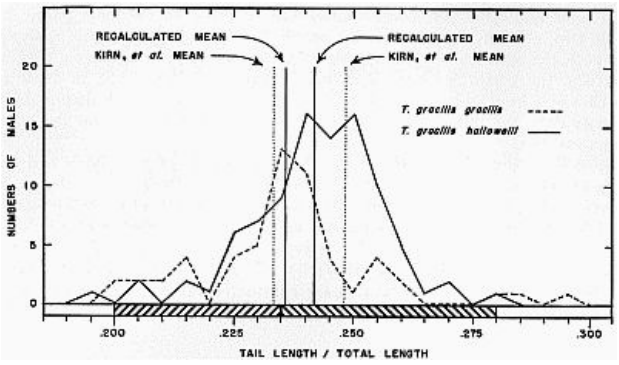

Fig. 6. Frequency polygons presenting ratios of tail length to total length for males of *T. g. gracilis* and *T. g. hallowelli* from Kirn, *et al.* (1949). The dotted vertical lines represent the means given by Kirn, *et al.* (1949) for *gracilis* (left) and *hallowelli* (right); the solid vertical lines represent the recalculated means for *gracilis* and *hallowelli*, respectively, using the data of Kirn, *et al.* The hatched bars represent the range included by Kirn, *et al.* (1949) in their diagnoses of *gracilis* (left) and *hallowelli* (right).

The data presented by Kirn *et al.* do not demonstrate intergradation between two populations. Moreover, the diagnostic ranges of the number of subcaudals in males of *hallowelli* and the ratio of tail length to total length in males of *gracilis* do not include the recalculated means for those characteristics. Furthermore, the means for the following characteristics are dangerously close to being excluded from their respective "diagnostic" ranges: in *hallowelli*, the number of ventrals in males; in *gracilis*, the number of subcaudals in females, and the ratio of tail length to total length in females. It is incongruous that Kirn *et al.* state (p. 243) that "the coefficient of geographic divergence is .6 per degree latitude" for ventrals, and on the same page they state that "The average number of ventrals gradually increases toward the north in *Tantilla gracilis* except in southern Oklahoma and central Arkansas (the area of intergradation between *T. g. gracilis* and *T. g. hallowelli*) where the change seems to be more abrupt." The data presented in Kirn *et al.* (1949) do not demonstrate an abrupt change.

The present sample of *T. gracilis* from Kansas is clearly within the geographic range of *T. g. hallowelli* as mapped by Kirn *et al.* (1949:241). However, for the sample from Kansas, the mean number of subcaudals of males is well within the diagnostic range for *T. g. gracilis* (Table 6), the mean number of subcaudals of females is closer to the mean of *gracilis* than it is to the mean of *hallowelli* (Table 5), and the mean of the ratio of tail length to total length of both sexes is within or very close to the diagnostic range for *gracilis* (Table 6). [Pg 627]

TABLE 6. Comparison of the Means of Some Characteristics of the Sample of *Tantilla gracilis* from Kansas (Our Data) with Some of the Diagnostic Characteristics (Kirn *et al.*, 1949:240) of *Tantilla gracilis gracilis*.

CHARACTERISTIC	Diagnostic range for *T. g. gracilis*	Mean of the sample ("*T. g. hallowelli*") from Kansas
No. of subcaudals males	40-50	48.4 (N = 109)
Tail L./ Total L. females	.160-.200	.20 (N = 79)
Tail L./ Total L. males	.200-.235	.23 (N = 109)

Smith and Sanders (1952:218) pointed out an error in the range of subcaudals in female *T. g. gracilis* as stated in table 1 (p. 247) of Kirn *et al.* We add some additional corrections that should [Pg 628] be made on the same page. In table two, column two ("Sex"), the words "male" and "female" are reversed for each characteristic. Also, in table two, column four ("Means from data of Force"), the means for caudals should be corrected from 33.61 to 43.61 in females and from 39.99 to 50.32 in males, as based on our recalculations from Force's data; we did not recalculate the means of Force's data for the other characteristics.

The discussion above demonstrates that the number of subcaudals and the ratio of tail length to total length are weak characteristics for diagnosing *T. g. gracilis* and *T. g. hallowelli*. The only remaining diagnostic characteristic given by Kirn *et al.* (1949) is the number of ventrals. Nevertheless, a step-cline in the number of ventrals, if one exists, is yet to be demonstrated. Therefore, we completely agree with Dowling (1957:32), who stated that "... the overlap in each character is so great that any subspecific differences appear to be as yet undefined. It is here suggested that *T. gracilis* be retained as binomial...." [Pg 629]

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Textual representation of complete dorsal scale formula on page 622.

$$15\frac{6+7(2)}{6+7(2)}13\frac{+7(4)}{+7(5)}14\frac{6+7(11)}{6+7(11)}15\frac{}{6=6+7(17)}13,$$

$$14\frac{}{6+7(18)}13\frac{}{+7(25)},$$

$$14\frac{+7(26)}{6+7(36)}15\frac{6+7(38)}{+7(39)}14\frac{}{+7(42)}13\frac{}{-6(45)}14\frac{}{+7(53)}15,$$

$$15\frac{7+8(67)}{+7(69)}14\frac{}{6+7(90)}15\frac{}{+7(93)}14\frac{}{6+7(99)}15\frac{}{+7(100)}14(122).$$

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