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ON CERTAIN MEXICAN SALAMANDERS OF THE PLETHODONTID GENUS *CHIROPTEROTRITON*

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THE plethodontid genus *Chiropterotriton* is a little known but conspicuous element in the fauna of many montane and plateau escarpment forests in northeastern México. Indeed, in places such as El Chico Parque Nacional, Hidalgo, the numbers of these salamanders suggest that they are often major vertebrate predators in their communities. The several species in northern México generally occur from altitudes of 3500 to almost 13000 feet, in a variety of plant formations, ranging from tropical evergreen or semideciduous forests to stands of fir. The genus has been recorded from Nuevo León to Costa Rica, but the species south of the Isthmus of Tehauntepec differ somewhat in skeletal anatomy and may be subgenerically separable from the species of northern México (Map 1), to which the present remarks are confined.

Generally slender in form, these salamanders resemble the more agile species of *Plethodon* of the eastern United States. The species vary in adult body size from about 25 to 50 mm., with a tail of nearly equal or slightly greater measure. The name alludes to one of the salient characteristics of the genus, the partial webbing of the feet, a feature which has probably promoted the cavernicolous and arboreal habits of several of the larger forms. These taxa may thus avoid to a considerable degree competition with small-sized members of the genus *Pseudoeurycea,* which is also widespread in the mountain forests but which, with two exceptions, is terrestrial. Save for the young of other forms, the smaller and more terrestrial species of *Chiropterotriton* are not sympatric with possible competitors (*Thorius, Parvimolge*). The species of *Chiropterotriton* frequently occur in pairs, which always consist of a small, terrestrial species and a larger, more scansorial one.

This ecological segregation is correlated not only with size but also with male dentition condition. Information presented herein impairs

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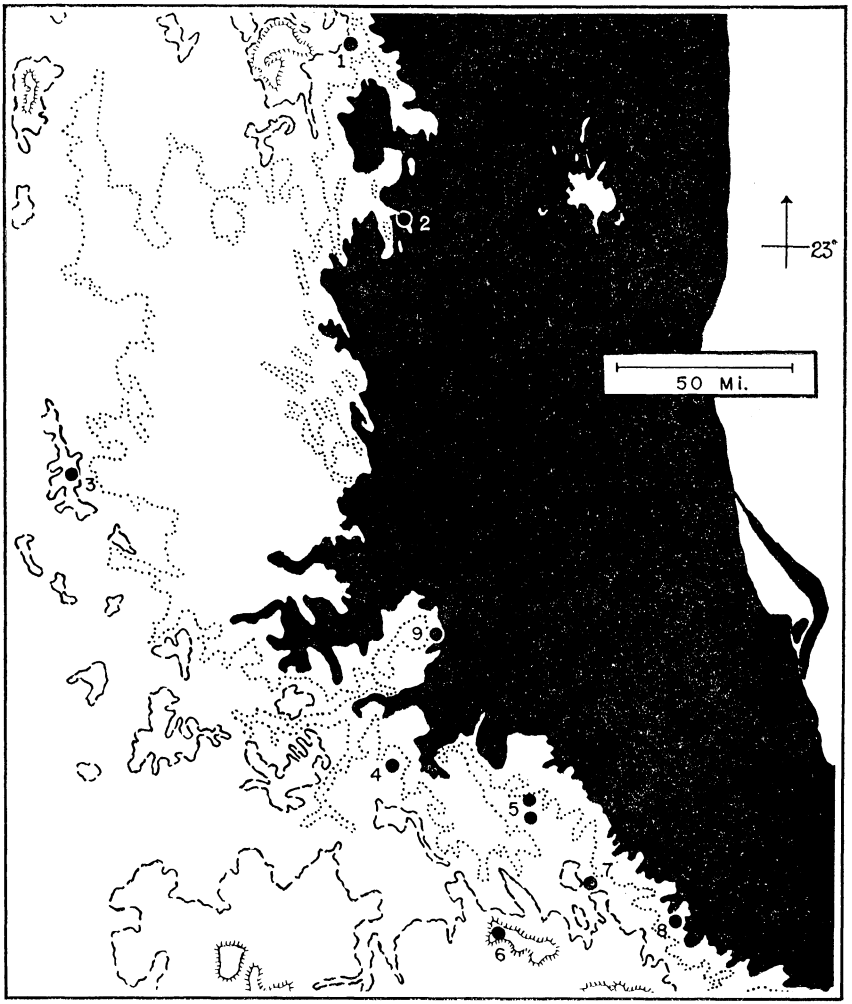
such a morphological division of the northeastern Mexican species, but in general it seems reasonable at present to associate the species *C. chiropterus,*[1] *lavae, dimidiatus,* and *chondrostega (terrestris)* as one subgroup and *C. multidentatus (sensu lato), arboreus,* and *mosaueri* as another. The former subgroup may also include *C. priscus,* a primitive form in some respects intermediate between *Chiropterotriton* and the *Pseudoeurycea cephalica* species group (Rabb, 1956).

The foregoing generalities may need drastic revision, for actual knowledge of these urodeles is scanty. Most of the recognized species were described by E. H. Taylor in a series of papers from 1939 to 1942. In 1944 Taylor described the genus *Chiropterotriton* and discussed its interspecific relationships in a general review of the plethodontids which previously had been lumped under the preoccupied name *Oedipus.* Since that time little new taxonomic or ecologic information has appeared, although studies on Taylor's material by Tanner (1952) and Trufelli (1954) have dealt with parts of the anatomy.

The criteria Taylor employed in distinguishing species were chiefly size, foot structure, and characters of dentition. Vertebral number (as determined by costal-groove count) and coloration, which have been of major importance in taxonomic work on plethodontids of the United States, have proved of little value in *Chiropterotriton.* The former is remarkably invariable among the Mexican plethodontids (see below); the latter has limited variability in *Chiropterotriton,* with similar patterns occurring in several taxa. The purpose of this paper is to present data gathered intermittently during the last three years on the various taxa, with particular reference to the variability of the difficult taxonomic characters Taylor employed. Some of the forms are still so poorly represented in collections that certain data are given as details of individual specimens. Treatment of two species, *C. chiropterus* and *lavae,* has been deferred until data from recent collections can be assembled.

Most of the specimens examined during my studies are in the collection of the Museum of Zoology of the University of Michigan (UMMZ). The major part of this material has been acquired since 1949, principally as a result of field work done in Tamaulipas by Paul S. Martin and Charles F. Walker, and in Veracruz and Hidalgo by James E. Mosimann, Thomas M. Uzzell, Jr., and myself. Numerous specimens from other institutions have supplemented this material, and I wish

[1]Dr. C. F. Walker has called my attention to the fact that the generic name is of masculine gender. The endings of several of the specific names have accordingly been changed. The name *chondrostega* has been treated as a substantive.



MAP 1: Northeastern México, showing localities mentioned. Area in black is below 3000 feet; dotted lines mark 5000-foot contour and dashed lines the 7000-foot contour; fenced areas are above 8000 feet. Direction marker is located at 23°N, 97°30'W. Black discs designate localities as follows: 1, El Chihue, Tamaulipas *(Chiropterotriton* sp.); 2, Rancho del Cielo, Tamaulipas *(C. multidentatus, C. chondrostega cracens)*; 3, Alvarez, San Luis Potosí *(C. multidentatus)*; 4, Durango, Hildalgo *(C. mosaueri, C. c. chondrostega)*; 5, Tianguistengo and Zacualtipan, Hildago *(C. arboreus, C. c. terrestris)*; 6, El Chico and Mineral del Monte, Hidalgo *(C. multidentatus, C. dimidiatus)*; 7, Apulco, Hildago *(C. chondrostega terrestris)*; 8, Mesa de Necaxa, Puebla *(C. arboreus)*; 9, Xilitla, San Luis Potosí *(Chiropterotriton* sp.). Not shown on map are two localities in Veracruz north of Agua Blanca *(C. chondrostega terrestris)*, about halfway between Apulco (7) and Zacualtipan (lower disc of 5).

to thank the curators involved in the loans: E. H. Taylor, for specimens from the Taylor-Smith collections (EHT-HMS) and the University of Kansas Natural History Museum (UK); H. M. Smith, University of Illinois Museum of Natural History (UIMNH); A. S. Loveridge, Museum of Comparative Zoology (MCZ); the late E. R. Dunn, Academy of Natural Sciences of Philadelphia (ANSP); and Doris M. Cochran, United States National Museum (USNM). CNHM is the abbreviation used for Chicago Natural History Museum.

I am also indebted to C. F. Walker and J. E. Mosimann for critical readings of the typescript, and to P. S. Martin for turning material over to me for study. W. E. Duellman contributed the photograph of the living individual of *C. multidentatus* and W. L. Brudon is to be credited with the other photographs.

Over half of some 900 specimens of the various taxa considered in this paper were examined in detail, but many of the others were old specimens not suitable for measurement or comparison with recently collected specimens. The measurements taken are described below.

Body length was recorded as the distance from the tip of the snout to the posterior end of the vent, the specimen being placed with its back on a millimeter rule. Recent workers on plethodontids have used this method (Stebbins, 1949) or have measured from the snout to the anterior end of the vent (Pope and Pope, 1949) At different times Taylor has employed both methods in his descriptions of species of *Chiropterotriton*. I feel that the method used here follows more natural criteria than the other since the trunk terminates at the posterior end of the vent, the two postsacral or precaudal vertebrae are included, and the basal constriction of the tail occurs immediately behind the vent and these two specialized vertebrae. Specimens of three species collected at all seasons of the year were examined, but there appears to be no seasonal enlargement of the cloacal area in these salamanders sufficient to affect the measurement appreciably (especially within the probable range of error due to different types of preservation). The procedure used here is therefore advocated as the standard one. Tail length was obtained by subtraction of body length from total length.

Certain head measurements were made with the aid of an ocular micrometer. Length measurements from the side were taken from the tip of the snout to the anterior angle of the eye, to the angle of the lower jaw, and to the lateral extension of the gular fold. Head width was measured at the maximal points, usually just behind the eyes. The eye opening was measured at its greatest horizontal diameter.

Vomerine (= prevomerine), mandibular, and maxillary-premaxil-

lary tooth counts were made under 30 × magnification of a dissecting microscope with strong illumination. The counts were recorded as the number of teeth from both sides. Throughout this report the maxillary-premaxillary count is referred to simply as the maxillary count.

Variation in the costal groove or space counts is so slight in *Chiropterotriton* as to be useless in comparisons (12 deviations from the usual 12 spaces or 13 grooves were observed in the first 750 counts, including at least 20 specimens each of six taxa). The number of costal spaces overlapped by (+) or between (—) the tips of the adpressed limbs was recorded to the nearest half-space.

Sex was determined chiefly by inspection of the cloacal walls for the papillae of the male or the smooth folds of the female. The gonads were checked in smaller specimens, and data were also recorded about them from certain adults.

The skeletal features of all of the named taxa except *C. arboreus* have also been examined through the use of twenty cleared and stained specimens and X-ray photographs.

Chiropterotriton multidentatus Taylor 1939

SPECIMENS EXAMINED.—San Luis Potosí, Alvarez, km. 53 on the Potosí y Río Verde railroad, *c.* 8000 ft., MCZ 14812 (holotype), MCZ 14810–11 (paratypes), ANSP 2116–20. Hidalgo, El Chico Parque Nacional north of Pachuca, 8000–9000 ft., UMMZ 105115–20 (229) and 106449–54 (291). Tamaulipas, Aserradero del Paraiso, 9 mi. NNW of Chamal, 1500 ft., UMMZ 111314–16 (72); vic. Rancho del Cielo, *c.* 5 mi. WNW of Gómez Farías, 3500–6200 ft., UMMZ 102903–6 (8), 105336 (8), 105354 (20), 105363–68 (83), and others.

The lumping of specimens from the several localities listed above under the name *multidentatus* is a conservative allocation, since it is apparent on the basis of several characters that the populations from Hidalgo and Tamaulipas are quite different from each other. However, I believe lack of material from the type locality in San Luis Potosí justifies this position. Description of some of the characteristics of the samples available is not overly hindered by this approach. Data from the larger series are in Tables I and II, pages 12–13.

HIDALGO SERIES

The large series from El Chico has afforded a chance to study the ontogenetic variation in one of the characters which has been given great weight in taxonomic work on the genus. The relation between

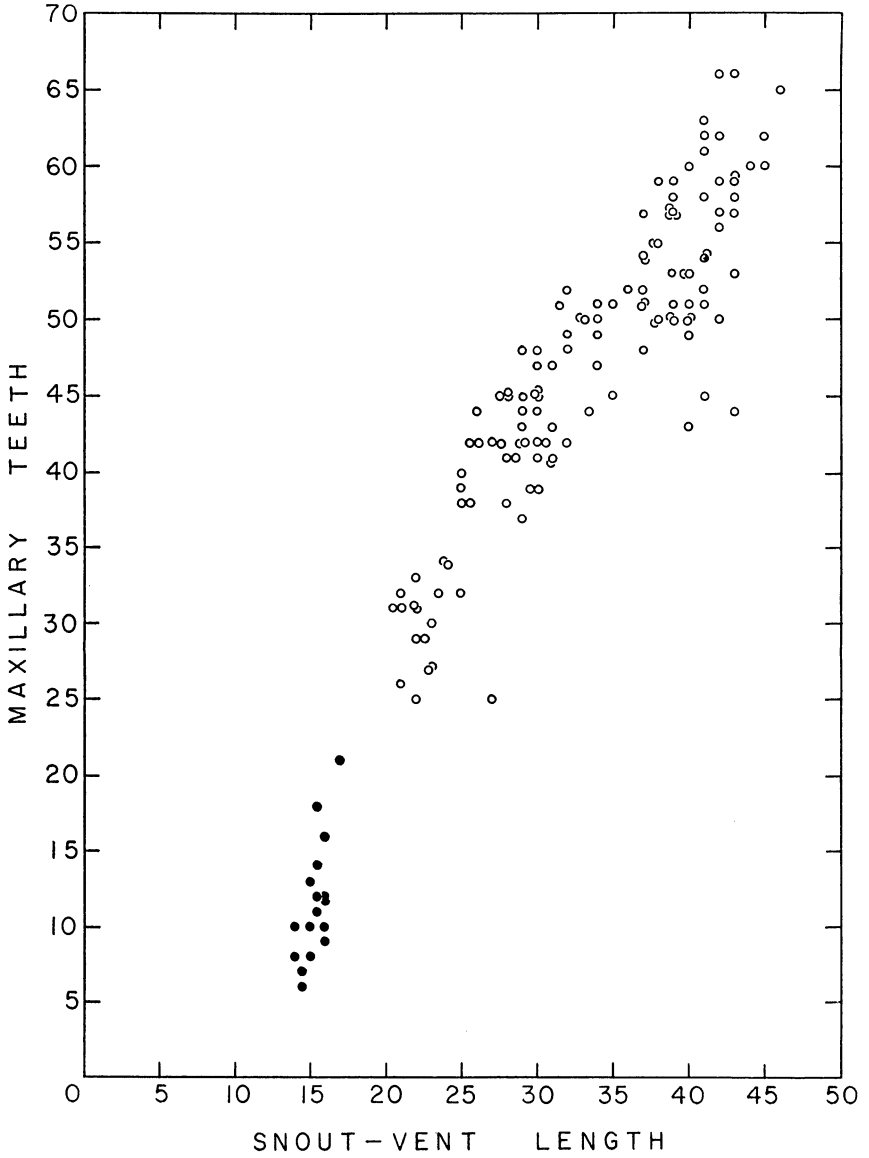


FIG. 1. The relationship of number of maxillary teeth to body size in females of *Chiropterotriton multidentatus* from El Chico, Hidalgo. Black discs are young of undetermined sex.

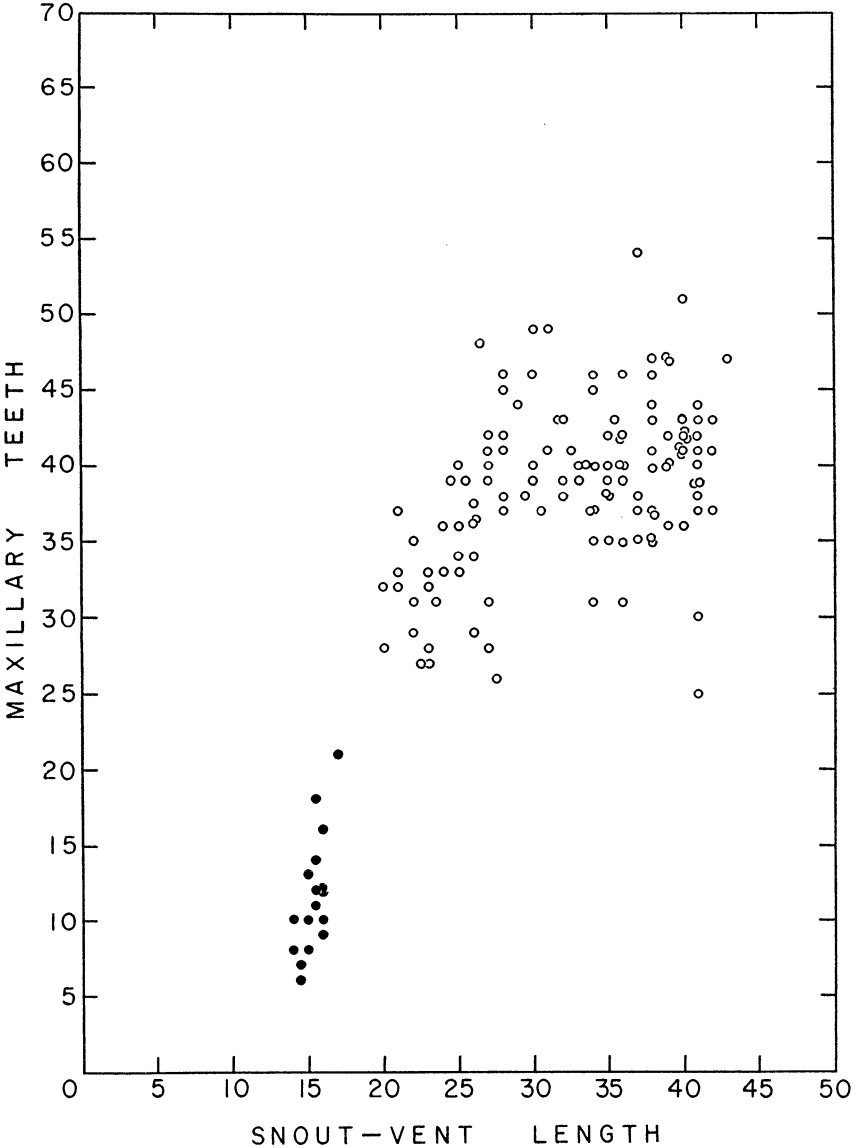


FIG. 2. The relationship of number of maxillary teeth to body size in males of *Chiropterotriton multidentatus* from El Chico, Hidalgo. The black discs represent the same undetermined young specimens as those of Figure 1.

the number of maxillary teeth and body size is illustrated by the accompanying graphs (Figs. 1 and 2). A line was computed by the method of least squares to describe the trend relating the number of teeth to logarithm of length in females. With 95 per cent confidence limits given for the constants, the equation for this line is: number of teeth $= 101.51 \pm 4.45$ (log snout-vent length) $- 107.04 \pm 0.67$. The correlation coefficient is 0.961. The males, however, show no progressive increase in number of teeth in the large size classes, and there is little to be gained by a linear description of the relation.

The change in the relation of number of teeth to body size in males evidently has some connection with sexual maturation, and accordingly the relationship of stage of maturity to body size was investigated. In the smallest group in which sex is ascertainable by gross inspection of the gonads (21–23 mm. body length), the testes are small and their surfaces devoid of pigment. In the 24 to 28 mm. group the testes are larger and exhibit varying degrees of melanic coloration. Approach of sexual maturity is indicated externally in the next size class (28–32 mm.) by the small papillae which line the cloaca. Two other characteristics of maturity, an externally visible mental gland and premaxillary teeth piercing the lip, occur together in individuals 32 mm. or more in snout-vent length. Among the adults in which all of these characters have appeared, an indication of more than one size (and evidently age) class is given by the number of testis lobes. The average size of 38 males, having bilobed testes, was 39.5 mm. (range 35–43), whereas that of 25 males, with the testis consisting of a single lobe, was 35.3 mm. (range 32–41). The work of Humphrey (1922) on *Desmognathus fuscus* and (presumably) *ochrophaeus,* in which as many as five lobes may be present, demonstrated convincingly that a higher number of lobes in those species was associated with greater size. The situation in *Chiropterotriton* (and other Mexican plethodontid genera) is probably more complex than I have indicated and is certainly worthy of further investigation.

Examination of the mental gland clusters of a few specimens indicated a general increase in number of glands and in size of glands and cluster with increasing body size. An opaque creamy material distinguishes these hedonic glands from the surrounding skin glands. This material is most conspicuous in the central glands, and its first appearance seems to be closely correlated with the eruption of the premaxillary teeth through the upper "lip." There is considerable variation in number of glands per cluster even when all of the glands are clearly distinct. Six specimens (34 to 37 mm. body length) had an average of

52 glands (range 45–61), and a like number of larger specimens (38–42 mm.) had an average of 80 glands (range 63–103). The length and width of the cluster in these two groups averaged 1.0 × 1.25 and 1.25 × 1.6 mm., respectively.

Figure 3 is a size-frequency graph of most of a sample taken at El Chico in September, 1951 (UMMZ 105115–20). In the males three or four size groups may be recognized. These represent immature individuals (20–29 mm.), papillate young (30–33 mm.), mature with unilobate testis (34–36 mm.), and mature with bilobate testis (37–42 mm.).

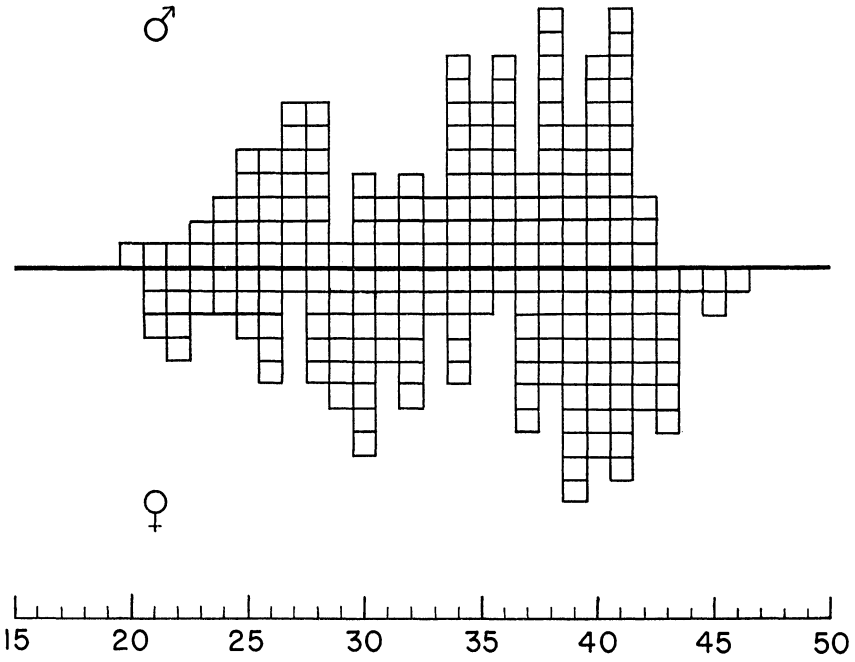


FIG. 3. Size-frequency graph of a sample of 231 specimens of *Chiropterotriton multidentatus* taken on September 2, 1951, at El Chico, Hidalgo. The scale at the bottom indicates snout-vent length in millimeters. Each square represents an individual.

The females do not conform very closely to the male pattern, for although the first group (21–27 mm.) certainly consists of immature specimens and the third group (37–46 mm.) has only mature individuals, the second group cannot be satisfactorily subdivided.

To judge from a very few examinations of the ovaries and oviducts, females are capable of reproduction at 35–36 mm. snout-vent length. Thus they appear to become mature at a slightly larger size than the

males. This and the larger size they attain may reflect a faster rate of growth, which would be in accord with work on other plethodontids (Highton, 1956; Stebbins, 1954; Pope and Pope, 1949).

Without year-round samples or information on winter activity, interpretation of the size-frequency data given is liable to error, but to judge from published studies on other plethodontids, it seems likely that individuals at El Chico may become reproductively active in their third season of life at an age of two years. Five of the females taken in September, 1951, had material believed to represent spermatophore capsules lodged in the cloacae. Many of the females from this collection had large eggs (2.0–2.5 mm. greatest diameter) and swollen oviducts, although there were few eggs on a side (3 to 7).

There is little variation in color pattern in this population relative to samples from Tamaulipas. The predominant appearance is uniform dark lavender-brown dorsally with cream-colored ventral surfaces. Other uniform dorsal colors occurring include light gray and tan. Most specimens have some lightening, or lack of pigment, in the rostral area, particularly along the canthi. Not uncommon in otherwise uniformly colored specimens is a small occipital spot of orange. Of 208 specimens checked, 20 had dorsolateral cream-colored stripes (or unconnected spots). Less frequent variants are those with a very dark dorsal band contrasting with lighter sides or having the dorsum brown and the sides dark lavender, with or without the cream dorsolateral stripes. Three extremes of pattern are illustrated in Plate I, upper row..

Among the abnormal specimens noticed in the large series, the most striking was a 38 mm. adult male (UMMZ S-1396) which lacked teeth on the premaxillary, maxillary, mandible, and prevomer and had a smaller than normal patch of teeth on the posterior vomerine shelf (= paravomerine, "parasphenoid" teeth). Clearing and staining revealed no evidence of any developing teeth about the toothless bones. Bifurcation of the tail was found in two of 500 specimens.

The sympatric presence of *C. dimidiatus* at El Chico gives rise to some difficulty in readily determining the identity of young specimens (14–20 mm. in body length). The following characters were found useful in discriminating between young of the two species: color pattern (*C. dimidiatus* is apt to be very dark ventrally and dorsally often has a distinctive pattern with very dark dorsolateral spots, whereas many young of *multidentatus* have light dorsolateral stripes which widen and abruptly terminate in the shoulder region with nuchal light patches appearing as discontinuous extensions of the stripes); limb proportions (*dimidiatus* has shorter, stouter limbs and smaller feet with more web-

bing); head features (the head width of *dimidiatus* is about the same as that of the body, in *multidentatus* the head is wider and bulges; the nostril is larger in *multidentatus* and appears more laterally directed due to the contours of the head; eye size does not seem to be a usable criterion).

TAMAULIPAS SERIES

Most of the specimens from Tamaulipas have been taken in bromeliads and caves at moderate altitudes (3500–4000 feet) in cloud forest near Rancho del Cielo. Some have been secured at greater heights in the pine-oak zone of the Sierra Madre Oriental, but only one collection has been made at a lower elevation. The latter came from a cave at Aserradero del Paraíso, in tropical deciduous forest at about 1500 feet, which constitutes the lowest altitudinal record for the genus in México.

With the exception of tooth counts, high and low altitude samples from Tamaulipas agree much more closely with each other than either does with the larger El Chico animals. In general, Tamaulipan specimens are more slender, have longer tails, flatter heads with more flaring snouts and rounded canthi, and have shorter digits than El Chico individuals of comparable size. They are also more variable in color pattern, with a generally less dense pigmentation than that found in specimens from El Chico. At least four basic color patterns are found in both high and low samples. Seventy-two specimens from Paraíso and 93 from the vicinity of Rancho del Cielo were classified according to pattern. Almost half of those from each place had a pattern featuring blackish mottling dorsally. Usually this mottling is found dorsolaterally, suggesting discontinuous black striping, but most individuals also have some dark spots middorsally and a V- or Y-shaped dark marking in the neck region. About one-fourth of both samples were uniformly colored dorsally with shades of brown and gray, but no close approach to the dark lavender of El Chico specimens was evident. Approximately a fifth of the salamanders had a broad dorsal band of tan or light brown contrasting with dark sides, in some cases strikingly so because of the very dark dorsolateral borders of the dorsal band. The remaining specimens resemble the uniformly colored individuals except for whitish mottling. This mottling was conspicuous dorsolaterally, resembling somewhat the broken stripes found in El Chico specimens. However, whitish streaks were found over the dorsum in several of these specimens. Except for the uniform pattern, these phases are illustrated in

TABLE I

Quantitative Features in Three Samples of the Chiroperotriton multidentatus Complex*

Item	Males			Females		
	El Chico	Paraíso	Cielo	El Chico	Paraíso	Cielo
Snout-vent length (mm.)	(62) 38.47±0.61 34-44	(40) 34.15±0.78 27-38	(21) 31.76±0.90 29-35	(56) 40.27±0.64 35-46	(17) 32.94±1.21 29-36	(20) 33.35±1.01 30-37
Tail/Total length (per cent)	(56) 50.85±0.41 47.22-53.93	(32) 56.88±0.53 53.16-60.00	(20) 53.97±0.85 50.70-56.52	(52) 49.69±0.51 46.25-54.95	(14) 54.36±1.28 50.00-57.32	(16) 52.81±1.06 48.57±56.33
Vomerine teeth	(61) 14.31±0.66 10-22	(40) 13.33±0.69 9-18	(21) 12.33±1.97 9-15	(58) 17.74±0.64 12-24	(17) 14.94±1.19 9-20	(20) 16.80±1.40 13-26
Maxillary teeth	(61) 40.12±1.28 25-54	(40) 41.15±1.56 31-53	(21) 35.86±2.81 27-53	(58) 54.81±1.42 43-66	(17) 54.88±4.59 44-72	(20) 60.55±4.01 39-85
Mandibular teeth	(20) 47.20±3.76 34-64	(40) 50.80±2.04 41-67	(16) 48.44±4.19 39-69	(20) 59.80±3.63 46-73	(17) 62.70±3.43 53-73	(12) 70.25±4.56 54-84

*In each triplet, the top figure represents the number of specimens; the figures on the middle line are the mean and 95 per cent confidence limits of the standard error of the mean; those on the bottom line are the range.

TABLE II

Costal Spaces Interval between Adpressed Limbs in Three Samples of the Chiropterotriton multidentatus Complex*

Sample	Number of Spaces							
	+1.0	+0.5	None	-0.5	-1.0	-1.5	-2.0	-2.5
62 males El Chico, Hgo.	1.6	4.8	46.8	29.0	14.5	3.2		
20 males Cielo, Tamps.			90.0	10.0				
40 males Paraíso, Tamps.		17.5	55.0	7.5	17.5	2.5		
56 females El Chico, Hgo.				3.6	21.4	33.9	39.3	1.8
21 females Cielo, Tamps.			47.6	14.3	38.1			
17 females Paraíso, Tamps.			17.6	41.1	35.3	5.8		

*Figures in columns are percentages of the respective samples; + indicates overlap of limbs, - indicates gap between limbs.

Plate I, lower row. Ventrally, there is ordinarily little pigment, but the Paraíso specimens are in general darker than those from Rancho del Cielo.

Females taken at Rancho del Cielo from early April through the end of May have contained small eggs (0.2 to 1.0 mm. in greatest diameter). A single mid-June female and several from the month of August have contained from four to six relatively large eggs (1.2 to 2.0 mm.) on each side. A group of small specimens was taken at this locality on May 25, 1949. The smallest individual (12.5 mm. snout-vent) was collected at Aserradero del Paraíso on April 25, 1953. Females secured at the same time had small eggs. The available data seem to indicate a late summer-fall laying period, with winter (?) or spring emergence of young.

Growth appears to be fairly rapid for most parts of the body. There is an actual decrease in the size of the nasal opening at about 16–17 mm. snout-vent length. The tail does not equal body length until the animal is about 25 mm. in the latter length. The first signs of sexual maturity, cloacal papillae, were found in one 26 mm. male, but this and other external changes (the mental gland cluster, enlargement of premaxillary teeth) generally do not become evident until the animal is about 29 mm. in length. Some females of 30–31 mm. body length were found to have medium- to large-sized eggs.

The forty adult males from Aserradero del Paraíso were examined for number of testis lobes. The testes and associated ducts were less heavily pigmented than in El Chico males. The twenty-six males with unilobate testes averaged 33.46 mm. in snout-vent length; the fourteen with bilobate testes, 35.64 mm. The unilobate group possesses slightly more maxillary, mandibular, and vomerine teeth than the bilobate group. The most notable difference is in the mandibular teeth, in which $\overline{X} \pm t_{.95}\, s_{\bar{x}}$ for unilobate males is 52.88 ± 2.44; for the bilobate group, 46.92 ± 2.68.

The identification of young at Rancho del Cielo involves rather subjective judgment since the two species occurring there are much closer in size than those at El Chico. The larger nostril, wider head, and different coloration of *multidentatus* were used to distinguish the two at 12–17 mm. snout-vent size. Larger specimens may be more readily separated on the basis of the larger limbs, eyes, and head width of *multidentatus*.

SAN LUIS POTOSI SPECIMENS

Data from five topotypes listed by Dunn (1936) as *chiropterus* are presented in Table III together with data from the holotype and the

TABLE III

Quantitative Features of Chiropterotriton multidentatus from the Type Locality in San Luis Potosí

Specimen	Sex	Snout-Vent Length	Tail Length	Adpressed Limbs Interval*	Vomerine Teeth	Maxillary Teeth	Mandibular Teeth
MCZ 14812	♂	38	50	+0.5	15	44	46
MCZ 14811	♂	31.5	40.5	None	10	37	41
MCZ 14810	♀	26	31	-1.0	15	37	57
ANSP 2116	♂	33	38	+0.5	10	36	49
ANSP 2117	♂	31.5	35.5	None	9?	30?	40?
ANSP 2118	♂	27	31	-0.5	10	50	49+
ANSP 2119	♂	27	28	-0.5	11	46	50
ANSP 2129	♀	33	37	-1.5	11	51	43+

*Measured in costal spaces, see Table II, note. +Uncertain number of additional teeth.

two paratopotypes. Most of the specimens are rather young and badly preserved, making comparison with the above-described samples difficult—color pattern, for example, has largely disappeared in the topotypes. I have examined the type, which is the only large adult available, but without the necessary comparative material on hand, I was unable to arrive at firm conclusions as to its relation to the Hidalgan and Tamaulipan populations. In size it is more like the former, in head shape and tail/total length ratio it seemed more like the latter or *C. arboreus*. The structure of the feet of *multidentatus (sensu strictu)* most closely resembles that of *arboreus* (compare the figure in Taylor, 1941*a*, with that of *multidentatus* in Taylor, 1944, Pl. 13, Fig. 6, labeled with the number of the holotype). If this holds for other adults from San Luis Potosí, foot characteristics will be quite useful in differentiating among the forms in the *multidentatus* group, but until additional topotypic material is at hand I feel that it would be unwise to apply other names to the Hidalgan and Tamaulipan populations of this complex.

Taylor (1949) recorded a specimen of *Chiropterotriton* from Xilitla, San Luis Potosí, indicating that its affinities were with *C. multidentatus*. As can be seen on Map 1, this locality is almost equidistant from the other three localities from which the *multidentatus* complex is known. Unfortunately, the specimen was in poor condition, having been taken from the stomach of a garter snake; however, the maxillary-premaxillary tooth count of 68 given by Taylor is rather high for any of the *multidentatus* complex, except females from Rancho del Cielo, and the specimen may well represent another species.

Chiropterotriton sp.

Five specimens collected by P. S. Martin and B. S. Harrell from west-central Tamaulipas warrant special mention. They are obviously related to the two Tamaulipan populations of *multidentatus* described above but differ sufficiently to suggest that they may represent another taxon. The specimens are UMMZ 111323–26 from El Chihue, 17 km. by road SE of Revillagigedo, Tamaulipas, México, *ca.* 6200 ft., collected on February 25, 1953, and UMMZ 111327, Ojitos Mine, *ca.* 2 miles west of El Chihue, 8600 feet, taken on the following day. These localities are about 65 miles north of the Gómez Farías region. According to Martin's field notes, the salamanders came from two small caves in rocky areas of pine-oak forests in which some trees bore large bromeliads. The cave at El Chihue also harbored *Pseudoeurycea scandens* and *Syrrhophus latodactylus*.

TABLE IV

Quantitative Features of Chiropterotriton sp., from El Chihue, Tamaulipas

Specimen	Snout-Vent Length	Tail Length	Adpressed Limbs Interval*	Vomerine Teeth	Maxillary Teeth	Mandibular Teeth
UMMZ 111323	42	57	None	15	54	64
UMMZ 111324	39	51	None	18	44	64
UMMZ 111325	42	50	+0.5	18	40	60
UMMZ 111326	32	39	None	14	47	52
UMMZ 111327	36	38	-0.5	22	56	66

*Measured in costal spaces, see Table II, note.

Individual data for this series, as shown in Table IV, reveal that this form reaches a greater size than the other Tamaulipan taxa, and probably correlated with this are higher tooth counts. Costal spaces between the adpressed limbs and length from eye to tip of snout are about the same in large individuals from the various places, the Chihue specimens thus having limbs of the same relative length, but shorter snouts. The most distinctive structural characteristic is the extensive webbing of the widespread feet (Pl. II).

The darker coloration of these specimens is also notable. The dorsal ground color was coffee-brown in life. In alcohol varying degrees of contrast appear between the dark sides and the lighter dorsal surfaces of the body and tail. The limbs are rather uniformly dark except for the palmar regions and the lightening around the wrist and ankle. The venter is also dark compared to most specimens of the *multidentatus* group examined, although approached by certain of those from Aserradero del Paraíso. Dark pigment is lacking in large areas from the gular fold anteriorly to the mental gland.

All five specimens are males, the smallest (32 mm. snout-vent length) having relatively minute papillae on the cloacal walls. The two smaller individuals have unilobate, the others bilobate, testes of elongate proportions. The mental gland cluster is not externally evident per se in any of the specimens, but melanophores are concentrated in that area of the skin.

Chiropterotriton arboreus Taylor 1941*a*

SPECIMENS EXAMINED.—Hidalgo, near Tianguistengo, EHT-HMS 16743 (holotype), UIMNH 27074–77 and MCZ 24546 (paratypes); 4 mi. S of Tianguistengo, UIMNH 30811–18; Puebla, Mesa de Necaxa, UMMZ 63945–48, 63953, 63955.

Individual data for most of the specimens listed are included in Table V. The two smallest specimens therein are males of 27 mm. snout-vent length, in which the mental gland clusters are not prominent, but numerous papillae line the cloacal walls. About 43 glands were counted in the mental cluster of UIMNH 27077 (34 mm. body length). Two larger paratypes, UIMNH 30912 and 27075, had from 90 to 95 glands. These counts are at variance with one of 205–7 given by Trufelli (1954) for a specimen 34.8 mm. in snout-vent length.

This species is a member of the *multidentatus* group characterized by its large terminal phalangeal pads, extensively webbed feet, a relatively small number of teeth, large-sized teeth (especially in males), and

TABLE V

Quantitative Features of Chiropterotriton arboreus

Specimen	Sex	Snout-Vent Length	Tail Length	Adpressed Limbs Interval*	Vomerine Teeth	Maxillary Teeth	Mandibular Teeth
EHT-HMS 16743	♂	38	49	None	13	31	--‡‡
UIMNH 27074	♂	37	50	None	16	29	35
UIMNH 27075	♂	36.5	49.5	+1.0	11	37	40
MCZ 24546	♂	36	46	+0.5	13	32	38
UIMNH 30912	♂	36	45	+0.5	10	25	35
UIMNH 30911	♂	35	37	None	10	32?	42
UIMNH 27077	♂	32	40	-1.0	10	26	38
UIMNH 30916	♂	30	34	-1.0	11	36	44
UIMNH 30913	♂	28	32	-1.0	10	33	37
UMMZ 63948	♂	28	32	-0.5	14	40	--‡‡
UIMNH 27076	♂	27	32	-0.5	9	32	44
UMMZ 63946	♂	27	36	None	12	30	--‡‡
UMMZ 63953	♀	33	35	-1.0	17	62	--‡‡
UIMNH 30914	♀	32	27+	-.05	12	34	36
UIMNH 30917	♀	32	35	-1.0	11	45	49

*Measured in costal spaces, see Table II, note. +Tail regenerated. ‡‡Count unobtainable.

coloration. On the basis of these and more subtle characters of proportion, it is apparent that three specimens (UMMZ 63946, 63848, and 63953) designated in an earlier paper by Taylor (1939: 289) as paratypes of *C. multidentatus* belong to this species. In the type description they were stated to have come from El Chico, Hidalgo, although in fact they were collected by H. B. Baker in "pine and alder" forests on the eastern edge of the plateau near Huachinango (Map 1). This hilly region is roughly continuous with the range in which Tianguistengo, the type locality of *C. arboreus,* is located, and is separated from the high fir-forested mountains of the El Chico area by dry reaches of the plateau and by broad arid valleys.

Two very young specimens, UMMZ 63947 and 63955, taken on July 13 and 23, 1927, respectively, and measuring 9.2 and 14.5 mm. in body length, were compared with a small specimen (14.1 mm. snout-vent) of *C. c. terrestris,* which is sympatric with *arboreus* in the vicinity of Tianguistengo. The two presumed young of *arboreus* were found to have larger narial openings and wider heads. The tail, more or less intact on UMMZ 63955, was considerably longer than that of the young specimen of *terrestris.*

Chiropterotriton mosaueri Woodall 1941

The type series comprises the only known specimens, despite efforts by at least two recent parties to find this long-legged cave-dwelling species near the type locality of Durango, Hidalgo. All of the specimens are males, including the smallest, MCZ 24576 (formerly UMMZ 88843), which shows no signs of maturity externally. Tooth counts, not given by Woodall for the paratypes, are presented in Table VI.

TABLE VI

Tooth Counts of Chiropterotriton mosaueri

Specimen	Snout-Vent Length*	Vomerine Teeth	Maxillary Teeth	Mandibular Teeth
UMMZ 88839	46	22	66	85
UMMZ 88840	44	17	60	74
UMMZ 88841	41	16	67	76
UMMZ 88842	40	22	64	80
MCZ 24576	28	14	69	68?

*In millimeters.

TABLE VII

Proportions in Selected Males of the Chiropterotriton multidentatus Complex

Item	Series*														
	Paraiso			Cielo			El Chico						Alvarez		
	PSM 3546	PSM 3538	PSM 3601	PSM 981	CFW 3170	PSM 973	AB 3213	AB 5290	AB 5210	AB 3222	AB 5270	AB 3150	MCZ 14811	ANSP 2116	MCZ 14812
Snout-vent (mm.)	37.8	36.8	35.6	34.8	34.5	35.3	34.2	34.9	36.8	38.0	40.0	41.5	31.5	32.9	39.5
Sn-jaw/Sn-v (%)	18.25	17.93	18.25	18.39	18.26	18.13	17.83	17.19	17.39	16.31	17.25	16.86	22.22	19.75	21.52
Head w/Sn-v	14.81	15.76	15.73	18.10	16.81	16.71	15.78	16.05	15.49	14.73	15.50	14.69	16.50	17.02	15.70
Head w/Sn-jaw	84.90	86.79	86.53	98.03	92.00	92.15	87.75	93.33	89.06	90.00	89.85	87.50	74.28	86.53	72.94
Sn-eye/Sn-jaw	36.36	35.84	32.69	32.00	33.33	30.60	30.61	30.00	29.69	32.00	31.88	28.57	32.85	33.33	31.76
Sn-eye/Head w	44.64	41.38	37.50	33.33	34.48	35.59	35.18	32.14	33.33	35.71	35.48	32.79	44.23	33.93	43.55

*UMMZ specimens referred to by field-tag numbers (PSM, CFW, AB).

TABLE VIII

Proportions in Selected Males of the Chiropterotriton multidentatus Species Group

Item	Chiropterotriton sp. (El Chihue)					C. arboreus			C. mosaueri		
	UMMZ 111323	UMMZ 111324	UMMZ 111325	UMMZ 111326	UMMZ 111327	UIMNH 27074	UIMNH 30912	UIMNH 27075	UMMZ 88839	UMMZ 88841	UMMZ 88842
Snout-vent (mm.)	41.8	38.8	41.7	32.5	36.2	36.6	36.8	37.1	46.3	42.5	39.2
Sn-jaw/Sn-v (%)	17.94	18.81	17.50	17.23	17.94	20.21	19.02	19.67	19.00	20.70	20.66
Head w/Sn-v	16.51	16.49	16.55	16.31	16.85	17.21	15.76	16.17	16.41	16.00	16.58
Head w/Sn-jaw	91.66	87.93	93.24	93.33	94.23	84.74	82.14	82.75	87.14	77.14	80.00
Sn-eye/Sn-jaw	33.33	34.48	32.20	28.88	28.84	33.80	34.29	35.61	38.57	40.00	32.30
Sn-eye/Head w	36.23	39.06	34.78	30.19	31.15	39.68	41.38	43.33	44.74	51.47	40.00

Woodall stated that *mosaueri* had a shorter head than *multidentatus,* but his head measurements appear erroneous. If Taylor's measurements of the type of *multidentatus* and my own of the type series of *mosaueri* are compared, the difference is certainly not marked. Large males of *multidentatus* from El Chico and Tamaulipas localities have shorter heads than these specimens of *mosaueri* (see figures, Tables VII–VIII). *C. mosaueri,* furthermore, has a comparatively elongate snout (Pl. II).

Chiropterotriton chondrostega chondrostega Taylor 1941*b*

SPECIMENS EXAMINED.—Hidalgo, Durango, 5000–6000 feet, EHT-HMS 17285, 17287, 17294, 17305–06, 17308–09, UIMNH 27041–44 (all paratypes); Durango, 6700 feet, UMMZ 106444.

Chiropterotriton chondrostega terrestris Taylor 1941*b*

SPECIMENS EXAMINED.—Hidalgo, 5–6 mi. N of Zacualtipan, EHT-HMS 23261, 23290, 23281, and 23297 and UIMNH 26883–902; 4–10 mi. S of Tianguistengo, UIMNH 26903–28 (all paratypes); near Zacualtipan, UIMNH 26868–82; Apulco, UMMZ 95250, 105356; Veracruz, 10 mi. N of Agua Blanca, 8860 feet, UMMZ 106445 (34); 7 mi. N of Agua Blanca, 8180 feet, UMMZ 106446 (21).

In Table IX a summary is presented of quantitative data from a few topotypes of *chondrostega,* some of the paratypes of *terrestris* from the Tianguistengo-Zacualtipan area, both series of *terrestris* from north of Agua Blanca, and specimens from Tamaulipas reported under the name *chondrostega* by Martin (1955). Relative leg lengths as measured by costal space counts between adpressed limbs are given for the same samples in Table X.

The differences between *chondrostega* and *terrestris* in number of teeth are apparent only among males of the specimens available. The premaxillary, maxillary, and mandibular teeth in males are large relative to those of females in both forms, although in several of the paratypes of *chondrostega* many of the teeth have been broken basally, and it is difficult to determine the usual size attained. The Tamaulipas series show markedly greater numbers of teeth in both males and females than any of the other samples. The teeth in the males are correspondingly smaller than in *terrestris* and *chondrostega.*

A further difference is found in males in which the teeth (specifically, those of the mandible, which are relatively easy to see) are at maximal size: the Tamaulipas ones are distinctly bicuspid, though the inner cusp is much larger; the inner cusp is hypertrophied in *terrestris* and

chondrostega and the teeth appear as large, curved, simple cones or spikes. Noble (1927) has described similar conditions in plethodontid genera of the United States.

Six nonpapillate males of *terrestris* from the vicinity of Agua Blanca, 20 to 24 mm. in body length, have an average of 32.5 maxillary teeth, with a range from 27 to 38. Three mandibular counts obtained from these specimens averaged 43 teeth. On comparison with the data for adult males from this area (Table IX), these counts appear as convincing evidence that there is reduction in tooth replacements with maturation. Though a nonpapillate male of *chondrostega* 20 mm. in body length has only 28 maxillary teeth, another measuring 22 mm., with minute papillae, has 38 teeth. Larger males have rather small teeth on the posterior part of the maxilla, as in *chiropterus*. This also suggests reduction. There are only four Tamaulipas males of comparable size (20.5 to 23.5 mm. body length). They have from 31 to 47 maxillary teeth, averaging 38 (adults average 44). It therefore seems that reduction does not take place in this form.

The weakness of the skeleton in these animals is obvious, but that certain dermal elements of the skull are largely cartilaginous, as Taylor indicated in his description of *chondrostega,* is unlikely. Specimens of the Tamaulipan form and of *terrestris* that have been stained and cleared appear normal in this regard for the genus, and X-ray photographs of these two forms and of paratypes of *C. c. chondrostega* show no substantial differences.

Tail and leg proportions are nearly the same in *chondrostega* and in the samples of *terrestris,* as the tabular data show, but in many individuals of *terrestris* the tail is not only short but noticeably stout. This could possibly be a seasonal condition subject also to local and individual variation. Such changes have been noted in *Plethodon richmondi* by Duellman (1954), and the ecological significance in *Batrachoseps* has been commented on by Hendrickson (1954: 16). The Tamaulipas specimens have comparatively elongate tails, which, with the somewhat longer limbs, give an impression of slenderness (Pl. III). There appears to be no seasonal change in the tail. This difference between the Tamaulipan form and *terrestris* may reflect contrasting habits.

The disparity reported by Trufelli (1954) between *chondrostega* and *terrestris* in number of glands in the mental cluster was not confirmed in the material examined. He recorded an estimate of 160–170 for *chondrostega* and one of 48–50 for *terrestris.* In two paratypes of *chondrostega* (UIMNH 27042–43) I counted 45–50 glands. Six specimens of *terrestris,* including paratypes, had from 46 to 64, averaging 56

TABLE IX

Quantitative Features of Subspecies of Chiropterotriton chondrostega*

Item	Males				Females			
	cracens	chondrostega	Topotypic terrestris	Agua Blanca terrestris	cracens	chondrostega	Topotypic terrestris	Agua Blanca terrestris
Snout-vent) (mm.)	(58)	(7)	(15)	(16)	(35)	(5)	(15)	(21)
	26.62±0.33	26.28±2.06	25.43±0.60	27.93±1.22	27.20±0.64	27.70±2.43	28.33±1.15	30.12±1.01
	24-29	22-29	23-27	23-21	24-31	25-31	25-31.5	26-35
Tail/Total (per cent)	(42)	(7)	(14)	(14)	(24)	(4)	(15)	(13)
	55.25±1.31	53.34±2.22	51.67±0.94	50.30±1.04	53.02±1.16	51.48±1.06	49.89±0.80	50.50±1.01
	49.06-61.54	51.11-54.84	48.89-53.57	45.61-52.54	48.07-57.75	50.82-52.46	48.00-52.38	47.54-52.38
Vomerine teeth	(57)	(7)	(13)	(16)	(34)	(5)	(15)	(21)
	13.65±0.68	10.29±1.89	10.15±0.80	10.56±0.93	16.15±0.95	12.20±2.98	12.60±1.21	14.00±0.77
	9-25	8-14	8-13	7-14	10-24	9-14	8-17	11-16
Maxillary teeth	(57)	(7)	(15)	(16)	(35)	(5)	(15)	(21)
	44.00±1.18	31.57±4.73	25.80±1.87	25.00±1.86	51.97±2.13	44.20±5.17	46.67±3.73	43.47±1.97
	33-58	23-38	20-31	19-32	40-66	38-49	36-56	33-52
Mandibular teeth	(57)	(6)	(12)	(16)	(32)	(5)	(11)	(21)
	54.11±1.37	37.66±5.32	30.58±2.28	31.81±2.48	59.20±2.23	49.60±5.66	47.91±2.89	48.14±1.88
	46-71	29-43	25-37	25-39	47-74	45-55	41-57	41-55

*For explanation of figures, see Table I, note.

TABLE X

Costal Spaces Interval between Adpressed Limbs in Samples of Chiropterotriton chondrostega*

Sample	Number of Spaces								
	-0.5	-1.0	-1.5	-2.0	-2.5	-3.0	-3.5	-4.0	-4.5
58 males Tamaulipas	5	16	19	17	1				
7 males Durango, Hgo.				1	3	3			
15 males Tianguistengo			2	10	2	1			
16 males Agua Blanca				2	5	8	1		
35 females Tamaulipas			1	8	10	13	3		
5 females Durango, Hgo.						1	3	1	
15 females Tianguistengo					1	3	1	10	
22 females Agua Blanca						3	4	13	2

*Measured in costal spaces, see Table II, note.

glands. Three males from Tamaulipas had from 46 to 50 glands. Some of the counts may be as many as 10 glands fewer than the actual number, but it is difficult to explain the discrepancy unless each gland of *chondrostega* that I counted is actually tripartite. The gland clusters of paratypes of *chondrostega* and *terrestris* and all of the Tamaulipan males were difficult to count because of their translucency or lack of cream-colored material. This may be a seasonal condition, similar to that reported by Weichert (1945) for *Eurycea bislineata*.

Color patterns in these series vary considerably, but can be considered as generally belonging to three types: uniform; laterally darker than dorsally, frequently with a distinct dark stripe which dips ventrally above the arm and dorsally at the base of the tail; and laterally darker than dorsally with cream or light reddish dorsolateral stripes which usually widen above the arms. A sample from a given area has a dominant pattern, although the three basic patterns are found at all four areas considered. Thus, the series from near Agua Blanca have the patterns represented in the following ratio: 15 uniform, 11 laterally dark (only), and 24 dorsolaterally light-striped. In the Zacualtipan-Tianguistengo region the ratio in the same order is 11: 37: 13. These animals are generally of a darker shade ventrally and dorsally than those from near Agua Blanca, and the dark stripes of the upper sides are very distinct and frequently broken, producing an effect like that of the "dark mottled" illustration of *C. multidentatus* in Plate I, lower row, left. This coloration is shown by three of the specimens illustrated by Taylor and Smith (1945: Pl. 20, nos. 5–7). The uniform pattern has been predominant in *chondrostega* from Durango (6: 2: 3), and this is also true of the Tamaulipas series (61: 20: 23).

On the basis of relatively high numbers of maxillary teeth found in some males of *C. chiropterus,* Davis and Smith (1953) suggested that *terrestris* might be a subspecies of *chiropterus*. Preliminary studies on *C. chiropterus* and *lavae* indicate that dentition reduction is to some extent a gradual process, but practically all large males have a small number of teeth, usually about half the number present in comparable adults of *terrestris*. This characteristic, the smaller size, and relatively smaller feet of *terrestris,* as well as the relative uniformity of *chiropterus* from several highland localities, do not seem to support the idea of a subspecific relationship between these two taxa.

Perhaps all of the forms under discussion should be distinguished by binomials, considering the differences mentioned previously and such uncertainties as reduction in male dentition, which appears to occur in *terrestris* but not in the Tamaulipas samples, with the condi-

tion in *chondrostega* probably one of reduction. The basic similarities of structure are such, however, that it is probably not presumptive to consider *chondrostega* and *terrestris* conspecific. Until further information is forthcoming, it is suggested that they be termed geographic races, distinguishable by the differences in tooth counts in adult males (Table IX).

Despite the distinctiveness of its dental features, the Tamaulipas population is here considered subspecifically related to these forms in view of the known (allopatric) distribution and the almost clinal nature of the quantitative characters. For this race I propose the name

Chiropterotriton chondrostega cracens, new subspecies

HOLOTYPE.—UMMZ 114069, field number PSM 2994, an adult male collected by Paul S. Martin on March 18, 1953, at "Agua Linda," elevation 5950 feet, about 7 miles WNW of Gómez Farías, Tamaulipas, México.

PARATYPES.—UMMZ 111320 (42), same data as the holotype; UMMZ 111319, La Lagunita, 6200 feet, 2.5 miles NW of La Gloria, Tamaulipas; UMMZ 105369–76 (37), 105344–53 (19), 105379 (3), 109234, CNHM 73810–11, vicinity of Rancho del Cielo at altitudes from 3000 to 4500 feet, about 5 miles WNW of Gómez Farías; UMMZ 102907–08 (11), MCZ 38273–4, Rancho Viejo, about 5 miles W of Gómez Farías, 4000 ft.

RANGE.—Known only from the listed localities in the mountains of southwestern Tamaulipas, México.

DIAGNOSIS.—A small slender form (adults 24 to 31 mm. snout-vent length) having a long tail (maximally one and a half times snout-vent length), and many maxillary (average 44 in males, 52 in females) and mandibular teeth (average 54 in males, 59 in females).

DESCRIPTION OF THE HOLOTYPE.—General appearance slender, head not noticeably wider than trunk, tail elongate. Tail quadrangular in cross section basally with about thirty-two indistinct grooves along its length, which is about one and a third times the length from snout to posterior end of vent. Costal grooves thirteen, counting ill-developed axillary and inguinal ones. Limbs well developed, hind leg slightly longer than foreleg. Limbs separated by about one and half costal spaces when adpressed. Innermost digits of hind- and forefeet enclosed in web. Web extending to sides of proximal phalanges on other digits and slightly farther on the third or longest digit.

Head rectangular in dorsal view, snout gently sloping in the canthal region. The snout gradually curved from eye to tip, the latter project-

ing anteriorly a little beyond lower jaw margin. Subnarial protuberances present but not prominent. Depth of snout about equal to the distance from anterior corner of eye to snout. The latter distance slightly less than the horizontal eye diameter and contained about three and a half times in measurement of snout to angle of jaw. Mental gland cluster not apparent externally.

A total of 44 maxillary and premaxillary teeth, practically uniform in size. Vomerine teeth in slightly arched rows of 7, separated medially by a distance equal to one choanal diameter. Forty-nine teeth in each of the indistinctly separated parasphenoid patches. Fifty-six mandibular teeth, somewhat larger than those of the maxillary series.

Coloration dorsally a light brown, sides a shade darker, but not contrasting. Venter flecked with dark chromatophores, giving a dirty cream appearance. Limbs not distinguished by any contrasting colors.

VARIATIONAL AND OTHER DATA.—Individual measurements on specimens of both sexes, including the holotype, are given in Tables XI and XII, along with those of a few specimens of *chondrostega* and *terrestris*. As is partly apparent from the data on adults in Tables IX, X, XI, and XII, the usual differences between the sexes obtain in this form: females reach a larger size, have shorter tails, legs, and snouts relative to body length, more rounded snouts, and more numerous and smaller teeth. No significant differences were found between the single large sample from Agua Linda and the several series from the lower stations near Rancho del Cielo. They have therefore been combined in the tabular data.

Young specimens (12–14 mm. body length) have been collected in late August and late May. Females taken in July and late August have small eggs (0.5–0.9 mm. diameter); those in collections made from March to May have quite large eggs (1.0–2.5 mm.). Whereas those taken in the late summer have numerous eggs (10–13 per side), the spring females have few (3–5 per side). Resorption may possibly account for this difference. The available data suggests that the breeding seasons of *cracens* and the Tamaulipas form of the *multidentatus* complex do not coincide, although they may overlap. In this respect *cracens* seems also to differ from *terrestris* and *chondrostega*, females of which taken from July through August have large eggs.

HABITS AND REMARKS.—Field observations by Martin (1958) reveal that this form has partly arboreal habits, although it is more terrestrial (but not more troglodytic) than its sympatric relative of the *multidentatus* complex. There may be some correlation between this partial arborealism and the slender body, elongate tail, relatively long legs,

TABLE XI

Measurements (in Millimeters) on Selected Males of Subspecies of Chiropterotriton chondrostega*

Dimension	cracens					terrestris			chondrostega
	PSM 2959	PSM 2994	PSM 407	CFW 3049	CFW 3043	UIMNH 26898	AB 5486	AB 5511	UIMNH 27043
Snout-vent	28.0	29.0	27.0	28.5	27.5	27.0	28.0	28.5	27.0
Tail	34.0	39.0	36.0	39.5	37.5	30.0	29.0	30.5	31.0
Axilla-groin	15.0	15.9	14.8	15.8	14.9	14.5	15.0	15.3	15.0
Hind leg	7.0	8.0	7.9	7.9	7.4	6.9	7.3	7.0	6.9
Snout-gular side	6.8	7.3	6.8	7.0	6.9	6.9	6.9	7.0	6.9
Snout-jaw angle	4.4	4.9	4.5	4.8	4.6	4.6	4.8	4.8	4.6
Snout-eye	1.3	1.4	1.4	1.5	1.5	1.4	1.4	1.4	1.5
Head width	4.4	4.4	4.3	4.2	4.3	4.4	4.4	4.3	4.2
Interorbital width	2.3	2.5	2.4	2.4	2.3	2.5	2.5	2.4	2.5
Internarial width	1.4	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.5
Eye diameter	1.7	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.6

*UMMZ specimens referred to by field-tag numbers (PSM, CFW, AB).

TABLE XII

Measurements (in Millimeters) on Selected Females of Subspecies of Chiropterotriton chondrostega*

Dimension	cracens					terrestris			chondrostega
	CFW 3199	CFW 3062	CFW 3059	PSM 404	PSM 1528	UIMNH 26884	AB 5505	AB 5491	UIMNH 27041
Snout-vent	27.5	31.0	27.0	31.0	29.0	30.0	30.0	30.5	30.0
Tail	36.5	41.0	34.0	33.0	36.0	34.0	29.0	31.5	31.0
Axilla-groin	15.6	18.0	15.9	16.3	16.6	18.0	16.6	16.4	16.9
Hind leg	7.6	8.1	6.9	7.9	7.5	7.1	6.9	7.4	7.3
Snout-gular side	6.6	7.1	7.4	7.1	7.0	7.1	6.9	6.9	6.9
Snout-jaw angle	4.5	4.9	4.3	4.9	4.6	5.0	5.0	4.6	4.6
Snout-eye	1.3	1.3	1.3	1.4	1.4	1.4	1.3	1.3	1.4
Head width	4.2	4.8	4.0	4.9	4.8	4.9	4.4	4.6	4.6
Interorbital width	2.4	2.5	2.2	2.5	2.3	2.6	2.3	2.5	2.4
Internarial width	1.3	1.4	1.3	1.4	1.4	1.4	1.4	1.4	1.4
Eye diameter	1.5	1.6	1.5	1.6	1.7	1.7	1.6	1.6	1.6

*UMMZ specimens referred to by field-tag numbers (PSM, CFW, AB).

and type of foot structure that *cracens* possesses. In contrast, *C. c. terrestris* has not been reported from bromeliads although sympatric *C. arboreus* is known only from them. The collections of *terrestris* near Agua Blanca were made in moist pine woods and in a meadow or llano surrounded by pine and oak woods. The type locality of *C. c. chondrostega* at Durango, Hidalgo, supports thin stands of oak and pine and is in general a drier area. Specimens of *cracens* from about the same altitude (Agua Linda, La Lagunita, *ca.* 6000 feet) are from moist pine-oak forests; those from lower altitudes near Rancho del Cielo were taken in "cloud forest." Descriptions of these two vegetation types have been given by Martin (1958).

For its inferential bearing on taxonomic ranking, it may be worthwhile to point out the intriguing parallel that the relation of *cracens* to *chondrostega* has with that of the Tamaulipas *multidentatus* to *arboreus*. Both Tamaulipas forms are more slender of body, tail, and limbs and have less webbing of feet than the Hidalgan taxa. Both also have a large number of small teeth in contrast to the fewer teeth (enlarged in males) of the Hidalgan forms. Both of the large forms are arboreal, but *cracens* is the only one of the small eastern Mexican taxa of *Chiropterotriton* under discussion known to occur in bromeliads.

Chiropterotriton dimidiatus Taylor 1940

SPECIMENS EXAMINED.—Hidalgo, Guerrero and El Chico, UMMZ 67654 (2),[2] UK 26143, UIMNH 30814; El Chico Parque Nacional, 9950 feet, UMMZ 105107–09 (23) and 106448 (30).

C. dimidiatus is the smallest species in the genus, and certain of its paedomorphic features (large nostrils, foot structure, and relatively short tail) appear to be correlated with size. The diminutiveness and dark coloration make for protective concealment in the deeply shaded forests at El Chico. If this is taken into account, *C. dimidiatus* was still greatly outnumbered (in actual ratio, 10 to 1) by its larger sympatriate of the *multidentatus* complex in two extensive collections made there by Mosimann, Uzzell, and myself.

Sexual dimorphism is well marked in this species, as is shown by the data on tooth counts and size presented in Table XIII. It is also evident in snout shape (truncate in males, rounded in females), relative leg length (adpressed limbs fail to meet by an average of four costal spaces in females, three in males), and in the mental gland cluster and prominent nasolabial protuberances of males.

[2] The number 67654 in Taylor's original description apparently refers to these specimens and not to any in the Museum of Comparative Zoology.

TABLE XIII

Quantitative Features of Chiropterotriton dimidiatus*

Sex	Item				
	Snout-Vent (mm.)	Tail/Total Length (per cent)	Vomerine Teeth	Maxillary Teeth	Mandibular Teeth
Males	(25)	(20)	(25)	(25)	(16)
	24.50 ± 0.50	47.29 ± 1.25	6.60 ± 0.56	12.20 ± 0.99	15.50 ± 2.15
	22 - 27	42.22 - 51.02	5 - 9	7 - 18	8 - 23
Females	(28)	(26)	(27)	(27)	(13)
	26.36 ± 0.68	44.95 ± 0.79	10.07 ± 0.93	39.00 ± 1.55	44.23 ± 2.61
	23 - 29	40.48 - 49.12	6 - 14	32 - 48	36 - 55

*For explanation of figures, see Table I, note.

Reduction in dentition of males leaves conspicuous gaps between persisting teeth. A *t* test of the means of maxillary counts of the five smallest adult males (22–23 mm. snout-vent), 15.2 teeth, and of the other twenty males, 11.45 teeth, was highly significant ($P < .01$).

Of 13 females taken on August 16, 1952, 11 have large eggs (1.2–1.6 mm. diameter) and partly or greatly enlarged oviducts, and one of the other two seems to have laid, since there were a few large but flaccid eggs as well as some small ones in the ovaries, and the oviducts were of moderate width. Of 15 females taken on September 2, 1951, three have large eggs and greatly enlarged oviducts, and one has fairly large eggs and moderate-sized oviducts. About half of the other females appear spent. These data suggest that the egg laying season is short, if it is assumed that there is little annual change in environmental conditions at the altitude of El Chico.

Forty-six of 53 specimens have a uniform brown dorsal coloration that is often bordered dorsolaterally by irregular dark purple stripes. Three have a broad dorsal band of quite light color and four have dorsolateral light stripes which contrast with the mid-dorsum and the sides. As Taylor (1940) mentioned, females do appear darker, particularly on the venter, than males. In life most of the specimens had an orange occipital spot, and in many the upper surface of the thigh (and rarely the forearm) was bright orange.

GENERAL REMARKS

It is apparent that definite statements on relationships of several of the taxa included in this paper would be premature. However, the relationship of the high and low altitude Tamaulipan populations here referred to *C. multidentatus* seems to deserve comment. The differences in number of maxillary and mandibular teeth and slight differences in proportions do not belie the essential similarity of the samples from Aserradero del Paraíso and Rancho del Cielo. They may therefore be considered as of the same taxon, despite the more pronounced sexual dimorphism in dentition of the latter and the similarities of the mean maxillary counts of the former to the El Chico, Hidalgo, series, which may be thought of as another taxon of the *multidentatus* complex. This brings in question the utility and importance of dental characters in discriminating among taxa in the genus. There is little pertinent information of help in resolving the problem, for no extensive studies of similar dental features have been made in salamanders. In *C. c. cracens,* no differences were found be-

tween samples separated by about the same altitudinal interval as the present samples of the *multidentatus* complex. However, recognition that the specimens from Aserradero del Paraíso probably represent a closely inbred population inhabiting one cave in a vegetational formation and at an altitude otherwise not known for *Chiropterotriton* may help explain the differences between them and the specimens from Rancho del Cielo. Nevertheless, this situation suggests that dental features be treated cautiously as taxonomic characters and that their relative weight may have to be adjusted or discounted in individual cases.

The data presented in this paper complicate the division of the northeastern Mexican species into two groups on the basis of size and reduction of dentition in maturing males. First, in the small species group there now appear to be various degrees of reduction among closely related taxa *(terrestris, chondrostega, cracens,* the last seemingly not showing the process at all). Second, though slight in degree, reduction apparently does occur in large species *(multidentatus* from El Chico and Tamaulipas, probably also *arboreus, priscus). C. priscus* is a large species not obviously related to any other form, but affinities with *C. chiropterus* may be indicated by similarities in general proportions. Additional differentiating characteristics would be helpful in deciding relationships, and they may be found through more thorough investigations of some of the characters mentioned previously *(e.g.,* mental gland clusters) as well as in the behavior and in the coloration of living animals.

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PLATE I

Upper row: Dorsal color patterns in *Chiropterotriton multidentatus* from El Chico, Hidalgo, showing extreme types described in text. Body proportions based on those of a large female.

Lower row: Dorsal color patterns in *C. multidentatus* from Rancho del Cielo, Tamaulipas. The proportions were based on an adult female.

PLATE I

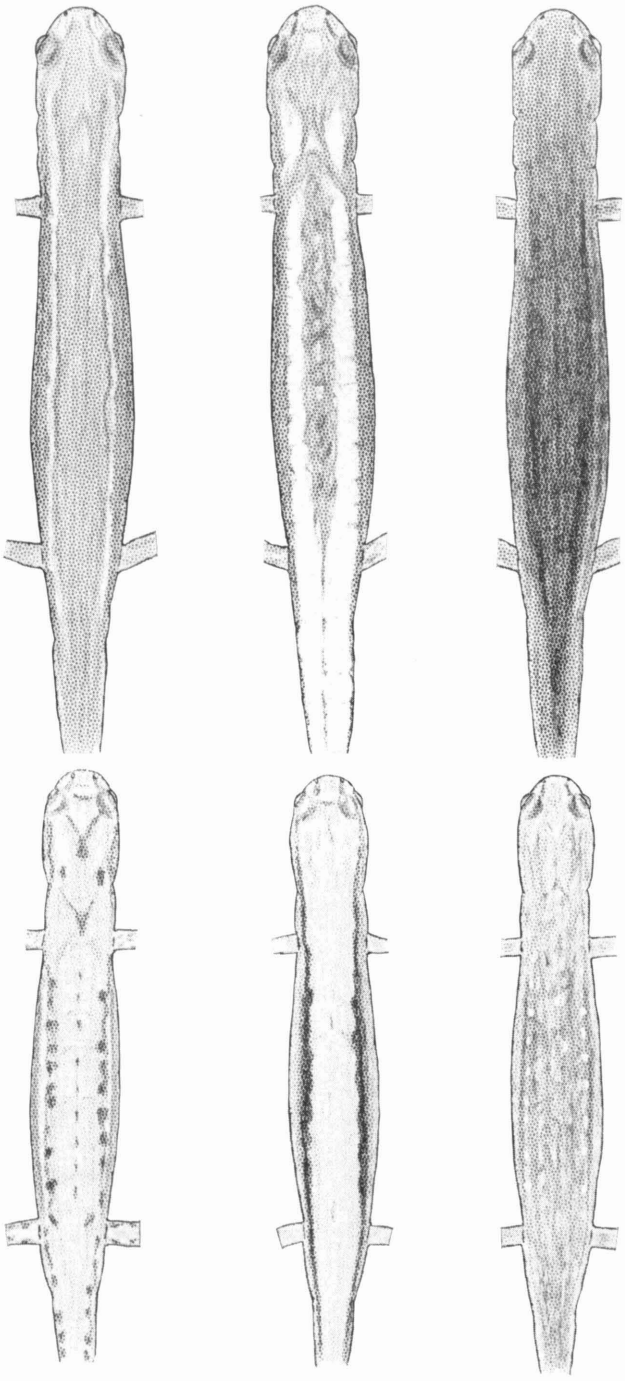
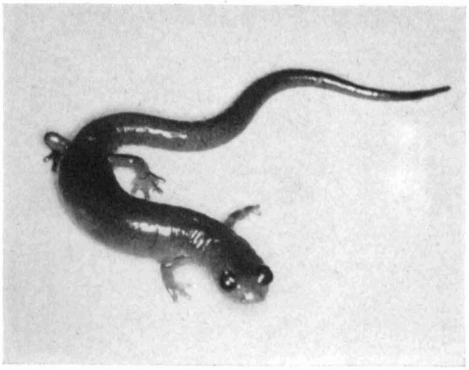


PLATE II

Upper left: *Chiropterotriton mosaueri,* UMMZ 88840, showing the elongate, blunt snout. Lower left: An adult female of *C. multidentatus* from Mineral del Monte, Hidalgo. Right: *Chiropterotriton* sp. from El Chihue, Tamaulipas, UMMZ 111325, showing the widespread, well-webbed feet.

PLATE II



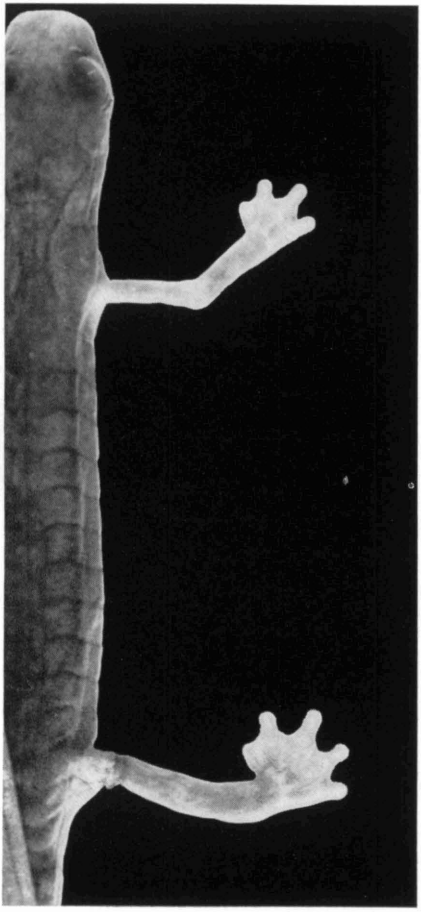


PLATE III

On the left, *Chiropterotriton chondrostega terrestris,* UMMZ 106446 (field number AB 5499), a male from north of Agua Blanca in Veracruz. On the right, *C. c. cracens,* UMMZ 111320 (PSM 2958), a male paratopotype from 7 miles WNW of Gómez Farías, Tamaulipas. The left hind foot is abnormal.

PLATE III