# A GEOGRAPHICAL REANALYSIS OF THE SCORPION GENUS *ANUROCTONUS* POCOCK, 1893 BASED ON MORPHOLOGY, MERISTICS AND MORPHOMETRICS

by

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A Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree

MASTER OF SCIENCE

Major Subject: Biology

West Texas A&M University

Canyon, Texas

August 2016

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# ABSTRACT

The scorpion genus *Anuroctonus* was considered monotypic for over a century before a new species, containing two subspecies, was described in 2004 by Soleglad and Fet. This resulted in three nominal forms: *Anuroctonus phaiodactylus* Williams 1863, *Anuroctonus pococki pococki* Soleglad & Fet 2004, and *Anuroctonus pococki bajae* Soleglad & Fet 2004. *Anuroctonus pococki pococki* contained enormous variation and it was likely that more species could be described. This study analyzed *Anuroctonus* morphology, meristics, and morphometrics and addresses problems of diagnosability from the original descriptions of the subspecies *Anuroctonus pococki pococki* and *Anuroctonus pococki bajae*. The variation in *Anuroctonus pococki pococki* was reanalyzed in a geographical context. Discriminant function analyses based on 13 morphometric ratios were performed in an exploratory fashion on populations in the ranges of both subspecies to determine statistical significance and diagnosability. *Anuroctonus pococki pococki* and *Anuroctonus pococki bajae* were elevated to species level after diagnosability was determined based on morphology.

## ACKNOWLEDGEMENTS

I am immensely grateful to Dr. W. David Sissom for his guidance and encouragement through this project. It would not have been possible without him; I'd like to thank my thesis committee: Dr. Lorenzo Prendini, Dr. Richard Kazmaier, and Dr. Rocky Ward. I am grateful to Dr. Lorenzo Prendini for his recommendation of this project and large contribution of specimens from the American Museum of Natural History, Dr. Lauren Esposito and Dr. Charles Griswold for the collections study grant and specimens from the California Academy of Sciences, and Dr. Paula Cushing for contribution of specimens from the Denver Museum of Nature and Science.

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CHAPTER I

## INTRODUCTION

The scorpion fauna of the United States currently consists of more than 110 species and subspecies, with all but four found west of the Mississippi River and the vast majority occurring in the southwestern states (Fet et al. 2000, Sissom 2016 via personal communication). One of the more interesting scorpion genera that occurs in this area is *Anuroctonus* (Fig. 1). This genus consists of two species, *A. phaiodactylus* Wood 1863 from Utah, Idaho, Nevada, and California and *A. pococki* Soleglad & Fet 2004 from California, USA and Baja California, Mexico (Soleglad and Fet 2004). They are medium-sized to rather large fossorial scorpions (39.53-74.38 mm) with robust pedipalps (pincers). Their body color ranges from pale yellow to dark reddish brown with the movable and fixed fingers of the pedipalp chela always dark brown to black. Sexually mature males develop a swelling at the base of the aculeus.

### Natural History

*Anuroctonus* is a genus of obligate burrowers that prefer packed sedimentary soils on hillsides with sparse vegetation (Williams 1966). Semi-arid climate, particularly chaparral, appear to have dense populations of these scorpions (Williams 1966). The chaparral in California is characterized by having broad leafed evergreens shrubs. Trees may or may not be present (Küchler 1947). The obligate burrowing behavior is supported by the observation that immature individuals start building oval-shaped burrows as soon as they are capable (Williams 1966). Time of increased activity has been documented in mature males as being July through September in Nevada (Gertsch and Allred 1965) and April through October in southern California (Williams 1966). Sexually mature males of *Anuroctonus* make up the majority of collections examined in this study leading to the conclusion that females remain in their burrows or rarely leave them. This conclusion is supported by Gertsch and Allred's (1965) survey of the Nevada test site where *Anuroctonus phaiodactylus* was collected in a ratio of 13 males to every female. Williams (1966) set 61 pitfall traps in Wildcat Canyon in San Diego County, California and only trapped mature males.

**The Genus *Anuroctonus* Pocock, 1893**

The genus *Anuroctonus* was established by Pocock (1893b) with *Centrurus phaiodactylus* Wood 1863 as the type species by monotypy. Subsequently, Thorell (1895) described the genus *Oncocentrus* for the taxa *A. phaeodactylus* (an incorrect subsequent spelling), and this name was declared a synonym of *Anuroctonus* by Kraepelin (1899). Since its establishment, the placement of *Anuroctonus* has been discussed in several publications and its relationship to other genera has been in contention. The genus was placed in the subfamily Iurini of the family Iuridae in the same paper *Anuroctonus* was described (Pocock 1893b). Its placement was subsequently reevaluated as follows: subfamily Vejovini within Scorpionidae (Kraepelin 1894), Vaejovidae (Penther 1913, Ewing 1928), subfamily Uroctoninae within Vaejovidae (Werner 1934a; Bücherl 1971b), subfamily Hadrurinae within Vaejovidae (Stahnke 1974b), and *genus incertae sedis* in Chactoidea (Francke and Soleglad 1981). More recently, Soleglad and Fet (2003a, 2004) placed *Anuroctonus* in the subfamily Uroctoninae within the family Chactidae, a placement found controversial by Prendini and Wheeler (2005) who returned *Anuroctonus* to its previous taxonomic position in the Iuridae.

**Focus of the Study**

After examining extensive collections of *Anuroctonus*, it is clear, as noted by Soleglad and Fet (2004), that there is a large degree of variation. This wide variation occurs both within and between populations, rendering morphological analysis complex and difficult. Williams (1966) described *Anuroctonus* occurring in dense, but disjunct, demes that exhibited strong habitat preferences. Most of the series examined from museum collections do not have habitat data and therefore correlation to habitat will not be examined in this study. The majority of gene flow between demes is likely only because of some migratory mature males (Williams 1966) which gives rise to the possibility that some populations may be moderately or even strongly isolated. This suggests additional unrecognized species may exist.

For over 100 years since its description, *Anuroctonus* remained a monotypic genus until a new species containing two subspecies, *Anuroctonus pococki pococki* and *Anuroctonus pococki bajae*, was described (Soleglad and Fet 2004). The same study also mentioned hybrid populations that exhibited characters of both subspecies in Banner Canyon and Laguna Mountain in San Diego County, California. After examining the diagnostic characters put forth by Soleglad and Fet (2004), it was found they frequently fail in diagnosing *A. p. pococki* and *A. p. bajae*. Soleglad and Fet (2004) also failed to report the full ranges of trichobothria counts, an important diagnostic tool among scorpions. Instead, they reported the plus-minus standard error range, which is useful for demonstrating statistical differences but does not serve the purpose of diagnosability. Therefore, the purpose of this study will be to reevaluate the diagnostic characters used by Soleglad and Fet (2004), reconsider the taxonomic validity and status of *Anuroctonus pococki bajae* and *Anuroctonus pococki pococki*, and more fully analyze the wide variation of morphological, morphometric, and meristic characters seen in populations of the three taxa in the genus.

CHAPTER II

# MATERIALS AND METHODS

Nomenclature for general morphology follows Hjelle (1990); mensuration follows Sissom, et al. (1990); trichobothrial designations follow Vachon (1974). Measurements were taken with an Olympus VM stereoscopic microscope calibrated with an ocular micrometer at 1x and 2x magnifications. Habitus photos were taken with a digital camera.

## Examination of Specimens Under Ultraviolet Light

Scorpions were examined under the microscope using an ultraviolet light. Utilizing this method minimizes visual illusions caused by infuscation (Volschenk 2005). For example, the structure of the ventral external carina on the pedipalp chela was used to diagnose *A. p. pococki* and *A. p. bajae* (Soleglad and Fet 2004). *Anuroctonus p. bajae* was described as having a granulated or pitted carina (Soleglad and Fet 2004). When some specimens were examined under normal lighting, the carina would appear pitted or granulated. When ultraviolet light was used, the carina would appear as a smooth ridge. An additional benefit of utilizing ultraviolet light is the ease with which setae and trichobothria (or their pits) can be seen (Volschenk 2005).

## Specimens

Specimens from three repositories and one personal collection were studied: The American Museum of Natural History (AMNH), the California Academy of Sciences (CAS), the Denver Museum of Nature and Science (DMNS), and the personal collection of W. David Sissom (WDS). Specimens from the entire range of *Anuroctonus* were examined. The California Academy of Sciences supplied most of the series from Utah, Nevada, and Baja California Norte, as well as some from California. Material from the Denver Museum of Nature and Science (DMNS) was mostly collected by the United States Geological Survey (USGS) utilizing pitfall trap arrays at designated USGS field stations in southern California. The American Museum of Natural History also supplied series collected by the USGS, as well as additional material from numerous locations. Each USGS field station was designated a separate population and reported separately unless otherwise stated. If a series was not from a USGS field station, they were grouped based on geographical proximity and potential for geographical isolation. Populations near each other without any isolating geography would be considered within proximity to each other. Other populations were separated if there was potential for a geographic feature to separate it, most commonly elevation (i.e. lowlands, canyons, and mountain ranges). Some populations were treated as isolated if there was a lack of sampling in adjacent areas even if no isolating geographic feature is apparent. The USGS assigned each of their field stations an acronym which will continue to be used in this study and all non-USGS populations have been assigned additional acronyms or have been included with the USGS series based on the criteria previously mentioned (Table 1; Figs. 2).

## Characters Examined

### *Pectinal Tooth Count*

The pectinal tooth count for each population was taken and recorded separately for males and females. This character was used to examine diagnosability and analyze geographic variation.

### *Trichobothria*

Important trichobothrial counts for males and females were recorded for each population. The chela and patella are noteworthy in that they have numerous accessory trichobothria (Vachon 1974). The number of trichobothria on the ventroexternal carina of the pedipalp chela and the trichobothrial arrangement and number of trichobothria on the pedipalp patella ventroexternal carina showed variability among populations. In particular, the trichobothria on the pedipalp patella in *Anuroctonus* are interesting. The trichobothria along the ventroexternal carina of the ventral face of the patella wrap around to the distoexternal face, i.e., the trichobothria continue distally from the ventral face to the external face in an arc. The accessory trichobothria of this arc were designated “wrap around” trichobothria (Soleglad & Fet 2004), and were counted separately from the trichobothria on the patellar ventroexternal carina. The trichobothrial counts were used to examine diagnosability and geographic variation.

### *Setae*

Setal counts of sternite VII, the metasoma, the pedipalps, and legs for males and females were recorded. Setae were counted on the dorsolateral, lateral supramedian, lateral inframedian, ventrolateral, and ventral submedian carinae on metasoma I-IV. Accessory setae were examined between the lateral inframedian carinae and the ventrolateral carinae, between the ventrolateral carinae and the ventral submedian carinae, and between the ventral submedian carinae. Setae were also counted on the dorsolateral, lateromedian, ventrolateral and ventromedian carinae on metasoma V. Setae were counted on the lateral and submedian carinae of sternite VII. The internal and external faces of the pedipalp femurs as well as the internal face of the pedipalp patella were examined for setae. For legs I-IV, the lateroventral row of setae on the patella and the setal arrangement on the telotarsi were examined. Setal counts were used for examining diagnosability and geographic variation.

### *Tarsal Spinules of the Legs*

On the ventral surface of each telotarsus exists a row of spinules. *Anuroctonus* possesses two distoterminal spinules, a mid-longitudinal row of spinules, and a basal “wrap around” arc. The row of spinules and the “wrap around” spinules were examined separately for legs I-IV. For legs I and IV, the basitarsi were examined for the presence of spinules or carinae. This character was used to determine diagnosability and geographic variation.

### *Granulation*

Interocular granulation was of particular interest because it has been used to separate taxa of this genus (Soleglad & Fet 2004). Ultraviolet light was used to determine the extent of granulation on the cuticlar surface. If the interocular area had no granules or only a few distal granules, it was evaluated as smooth. Subsequent degrees of granulation were comparitively evaluated to determine whether it was lightly, moderately, or heavily granulated. Light granulation was characterized by only having a few scattered granules that extended beyond the distal regions. Moderate granulation was characterized by larger patches of granulation but not entirely covering the interocular area. Heavy granulation was characterized by the entire interocular area being covered in granules. Males and females were reported separately because of sexual dimorphism present in this character. Only sexually mature individuals were evaluated. Solelgad and Fet (2004) used the granulation of the ventroexternal carina of the pedipalp chela as a diagnostic character for *A. p. pococki* and *A. p. bajae*. This character was reevaluated. Granulation characters were used to examine diagnosability and geographic variation.

***Color***

Several qualitative evaluations of color and infuscation were recorded. Base color was recorded as pale yellow, yellow brown, reddish brown, or dark brown. The presence and intensity of infuscation on the carapace, the pedipalp femur, the legs, and the metasoma were examined and rated as being absent or lightly, moderately, or heavily infuscate. Telson color and infuscation were also examined. The presence and intensity of infuscation of the digital carina on the pedipalp chela, a diagnostic character used by Soleglad & Fet (2004), was reevaluated as being absent or lightly, moderately, or heavily infuscate. It was also noted whether the carina contrasted with the base color of the intercarinal integument.

Relative leg color compared to body base color (e.g., light legs with dark body) was recorded. Only sexually mature individuals were evaluated. Males and females were evaluated separately. Color characters were used to examine diagnosability and geographic variation. For an analysis of geographic variation in *A. p. pococki*, the character was coded ordinally: (0) absent, (1) lightly, (2) moderately, and (3) heavily. Means and standard deviation were calculated. The infuscation of the digital carinae was also statistically analyzed in a discriminant function analysis.

### *Ocular Tubercle*

When examining *Anuroctonus*, it became apparent that the shape and distribution of pigment on the ocular tubercle were highly variable. The general shape of the tubercle was recorded. The shape was determined by the relative extent of the anterior and posterior portions to the median eyes (e.g., anterior portion longer than posterior) as well as the space between the median eyes to determine relative width. Pigment distribution was described based on which portions of the ocular tubercle had black pigment present. Only sexually mature individuals were evaluated. Males and females were examined separately. The ocular tubercle characters were used to evaluate diagnosability and geographic variation.

### *Carination*

The development and strength of carinae on the pedipalp chela, pedipalp patella, pedipalp femur, sternite VII, and metasoma were examined. The carinal development was recorded as absent, weak, moderate, or strong; the degree of granulation was recorded as smooth, granular, granulose, or crenulate. The crenulate carinae were also recorded as fine or coarsly crenulate determined by the number of crenulations. Only sexually mature individuals were evaluated. Males and females were examined separately. Crenulation was used to examine diagnosability and geographic variation.

### *Mensuration*

Geographically separated populations were measured for a preliminary analysis. Measurements were chosen based on those showing larger variability among and between populations (Lubischew 1962). The following measurements were taken for each specimen: (1) pedipalp chela length; (2) pedipalp chela width; (3) pedipalp chela depth; (4) pedipalp femur length; (5) pedipalp femur width; (6) pedipalp chela movable finger length; (7) pedipalp chela fixed finger length; (8) carapace length; (9) metasoma I length; (10) metasoma I width; (11) metasoma V length; (12) metasome V width; (13) telson length; (14) telson vesicle width; (15) telson vesicle depth; (16) leg IV patella length; (17) leg IV patella width; (18) total body length.  The following ratios were calculated using these measurements: (1) pedipalp chela length/pedipalp chela width; (2) pedipalp chela length/pedipalp chela depth; (3) pedipalp chela width/pedipalp chela depth; (4) pedipalp femur length/pedipalp femur depth; (5) pedipalp chela movable finger length/pedipalp chela width; (6) pedipalp chela fixed finger length/carapace length; (6) metasoma I length/metasoma I width; (7) metasoma V length/metasoma V width; (8) pedipalp chela fixed finger length/pedipalp chela length; (9) carapace length/metasoma V length; (10) telson length/vesicle depth; (11) telson length/vesicle width; (12) metasoma V width/vesicle width; (13) leg IV patella length/leg IV patella width. Only sexually mature males and females were measured and were examined separately. The resulting mophometrics were used to examine diagnosability, geographic variation, and were used in the discriminant function analyses.

**Statistics**

Ratios of measurements are frequently used in scorpion taxonomy to control for body size and the effects of sexual dimorphism. Male scorpions tend to have exaggerated length compared to females having larger body size overall (Fox et al. 2013). There is also a component of maturation at different instars that makes ratios more appealing than raw measurements when utilized for diagnoses. Some have questioned the use of ratios in statistical analyses because the data may not be normally distributed and can have correlation of the numerator and denominator influencing statistical results (Humphries et al. 1981). It has been suggested, however, that utilizing ratios does not necessarily lead to incorrect conclusions, be it erroneous perception of significance or lack thereof. Packard and Boardman (1988) found that 72% of ANOVAs conducted on ratios resulted in the same conclusions of ANCOVAs conducted on raw data sets controlled for body size. Criticisms of ratios tend to focus on measurements divided by a common denominator, usually overall size, or a measurement that acts as its own denominator (Atchley et al. 1976, Humphries et al. 1981, Packard and Boardman 1987, Austin et al. 1999). That is not the case here as the ratios used in this study give proportional measurements (e.g., pedipalp chela length/pedipalp chela width gives a measurement of robustness of the pedipalp chela). Since the results of statistical analyese performed on raw data sets compared to ratios agreed the majority of the time, and therefore doesn't constitute a fatal violation, and the major criticisms of ratios or not applicable to the ones used in this study, it would be acceptable to utilize ratios at least in an exploratory method.

Given that the populations were assigned *a priori,* and there is no assumption that these populations are the same species, a preliminary stepwise Discriminant Function Analysis (DFA) was performed on sexually mature males of populations selected for maximum distribution through the ranges of *A. p. pococki* and *A. p. bajae* (Humphries et al. 1981, Lubischew 1962). Two more DFAs, also using a stepwise procedure, were seperately performed on populations found in the ranges of *A. p. pococki* and *A. p. bajae* after the preliminary analysis. This method was preferred over a Principle Components Analysis (PCA) because of the *a priori* assignment of populations (Humphries et al. 1981). The DFA was performed in SAS® software (SAS Institute Inc. 1988).

CHAPTER III

# RESULTS AND DISCUSSION

## Statistics

A discriminant function analysis (DFA) was performed on sexually mature males of populations of *A. p. pococki* and *A. p. bajae* (Fig. 3). Some populations had sample sizes that were smaller than ideal for use in a DFA. Out of the 16 populations evaluated, 11 had less than 10 scorpions. Unfortunately, small sample sizes of populations is a common limitation in ecological, systematic, and taxonomic studies which is why the DFAs performed in this study are strictly exploratory. In the first DFA, populations from both species were included as well as the ordinal character for the intensity of infuscation on the digital carina (Fig. 4). This character was coded as: (0) unpigmented or lightly pigmented; (1) moderately pigmented; (2) heavily pigmented. The stepwise procedure added seven variables with significant discriminatory power (Table 2). The pigmentation on the digital carina had a very large discriminatory power and drowned out other variability. In general, the populations in the *A. p. pococki* range separated to the left and *A. p. bajae* to the right on the graph. Soleglad and Fet (2004) had also determined presence and degree of infuscation of the digital carina to be a diagnostic character of the two subspecies. Population A is found in the *A. p. pococki* range (i.e., individuals all had heavily infuscate digital carinae) but was difficult to code as it had individuals ranging from non-contrasting to distinctly contrasting.

In the second DFA, the character for digital carina infuscation was removed and the analysis only contained morphometric ratios (Fig. 5). Canonical function 1 was plotted against Canonical Function 2 to demonstrate 60% of the discriminatory power. In this DFA, populations A and E were completely or nearly completely separated from the rest. Population I was also nearly separated. Populations from the *A. p. pococki* range ordered themselves on the left side of the scatterplot and *A. p. bajae* on the right. The stepwise procedure determined that chela length/chela width had the most discriminatory power along with six other variables (Table 3). This DFA supported the conclusion that *A. p. pococki* and *A. p. bajae* were statistically different. Since the infuscation of the digital carina had a strong discriminatory power, subsequent DFAs were performed separately on populations with and without infuscation.

The third DFA was performed only on populations that had digital carina that only ranged from unpigmented to lightly infuscate. Based on the previous DFAs, it was assumed these populations would be diagnosable as *A. p. bajae*. The stepwise procedure determined three variables with significant discriminatory power with leg IV patella length/width being the most significant (Table 4). This DFA produced an interesting progression of polygons in a north to south order from left to right with each slightly overlapping the next (Fig. 6). Population I mostly separated from the rest of the populations. It was initially thought to be *A. p. bajae* because of its apparent lack of strong infuscation on the digital carina and overall color being pale yellow. After consideration, preservation method came into question for these specimens and fading of the color became a possibility. It was then determined that population I did not belong with *A. p. bajae* because of questions that arose about the preservation method used altering color and infuscation. Because of these questions, it was removed from the DFA.

The next DFA included all populations (tentatively assigned to *A. p. bajae*) without strong infuscation on the digital carina minus population I. The stepwise procedure determined two variables with significant discriminatory power with pedipalp femur length/width having the most (Table 5). Canonical function 1 was plotted against canonical function 2 and contained 91.6% of the discriminatory power. The populations still roughly ordered in a north to south direction with slight overlap of each subsequent polygon (Fig. 7). After reexamination, population D was also found to be problematic. There were series to the northwest of the San Jacinto Mountains that were actually diagnosable as *A. p. pococki* and series to the southeast that appeared to be *A. p. bajae*. The specimens used were diagnosable as *A. p. bajae*, but this should be taken into consideration when interpreting the DFA. Again, the polygons arranged themselves in a North to South order, but better sampling along the geographic range of *A. p. bajae* will improve the DFA.

A DFA was also performed on populations with pigmented digital carinae. The stepwise procedure produced six variables with significant discriminatory power (Table 6). The ratio pedipalp chela length/width was the most powerful. The DFA produced a plot where populations E, A, and P separated significantly from the rest of the populations. Population B also had fairly little overlap but did not overlap with A or E despite being in geographic proximity to E (Fig. 8). Population P was originally considered to be *A. p. pococki* because of the development of the digital carina being partially more developed than was typical of *A. phaiodactylus* albeit more weakly developed than others. It was later determined to be *A. phaiodactylus* because of the granulation of the interocular area being diagnostic of *A. phaiodactylus* and that the carinae were still weak overall with moderate development basally. This also explains why population P had significant separation from the rest. Population P was removed and another DFA was performed.

The last DFA was performed with all the populations of the previous DFA, sans population P. Canonical function 1 was plotted against canonical function 2 and contained 80.8% of the discriminatory power. The stepwise procedure produced seven variables with significant discriminatory power (Table 7). The ratio chela length/width again held the most discriminatory power. Populations A and E remained separate with little to no overlap with other populations. Population B had slightly more overlap with P removed and population L was further separated (Fig. 9). Population L, however, had only three individuals included and an increase in overlap might occur with the inclusion of more.

## Anuroctonus pococki pococki Variation

### *Color*

*Body color vs. leg color.* The overall body color compared to leg color was evaluated for geographically distributed populations. They were recorded as dark body/light legs or non-contrasting legs. These were evaluated comparatively and only if the legs contrasted with overall body color, regardless of darkness. The majority of the *A. p. pococki* range had dark bodies with light legs. There are a few populations that exhibited non-contrasting legs. These populations are mostly in the northern part of the range with one located in Baja California. All the coastal populations have dark bodies with light legs while populations slightly inland could exhibit either (Fig. 10). Most scorpions with non-contrasting legs were also paler in overall color. There is no other geographic pattern regarding this character. In some of these populations, there is a question as to whether the color was affected by preservation method. The scorpions in these series were collected around the same time period and mostly by the same collector. There is a possibility the method of preservation caused an overall fading in coloration.

*Infuscation*. The general pattern of infuscation was examined. This character was also highly variable. Patterns were evaluated based on presence or absence on the carapace, pedipalp femur, tergites, and each metasoma. Fuscosity was sometimes difficult to see because it could be extremely light or restricted to small areas. This resulted in eight general patterns of fuscosity (Fig. 2; Table 8). Populations DMM, DLM, SMR, WCC, and CHI were the most consistent in fuscosity patterns with all of the body parts examined being fuscous in every scorpion (acronyms defined in Table 1). In patterns where a particular area was variable, the fuscosity did not extend to more than lightly fuscous with few exceptions. Populations TEN and TOR included more than one USGS field station and differed in fuscosity patterns at each. In TEN, Tenaja Corridor 1 was more variable in fuscosity than Tenaja Corridor 2. In TOR, Torrey Pines 2 was more consistent in fuscosity pattern than Torrey Pines 1 or 3. Variability in fuscosity pattern and extensiveness of fuscosity increases as it radiates outward from population DMM.

*Digital carina.* The digital carina on the pedipalp chela exhibited large variation within and between populations in the range of *A. p. pococki*. The populations were evaluated on the degree of infuscation on the digital carina in sexually mature males and females. Some populations also had individuals that had infuscate carinae that did not contrast with the overall body color and could be erroneously designated unpigmented without careful examination. The infuscation was recorded as lightly, moderately, or heavily infuscate.

Through visual inspection, there was no geographic pattern apparent with infuscation of the carina but some populations appear to have more variation than others (Figs. 2, 11). Males showed the most variation. Many populations have lightly to heavily infuscate carina and this variation can be seen within a single series. Populations DMM and SGM have a small number of individuals with non-contrasting digital carinae which makes it difficult to evaluate the intensity of infuscation. Population SGM, however, is one of the populations with questionable fading in color. Some of the populations evaluated have very few specimens available so there remains a possibility that the variation would increase in some of these populations with a larger sample size. Females most commonly ranged from lightly to moderately infuscate with some populations in Orange County and inland San Diego County with heavily infuscate carinae. Females were more likely to have non-contrasting digital carinae than males with 22% of females

(15; n=68) having non-contrasting carinae and 0.01% of males (3; n=238).

***Ocular Tubercle***

Ocular tubercle shape and pigmentation were evaluated for each population in sexually mature males and females. The tubercle shape was highly variable and was evaluated by the relative length of the anterior and posterior portions as well as the overall thinness. They were recorded as equal, slightly longer anteriorly, or longer anteriorly. There were a few individuals with longer posterior portions but this was unusual and the specimens were not in geographic proximity to each other.

The shape of the ocular tubercle changes in a radiating pattern with its center at population DMM. Population DMM has all but one scorpion with equal anterior and posterior portions. As populations were progressively further away from DMM, the frequency of equal parts decreased and the frequency of slightly longer anterior to longer anterior portions increased. While a scorpion with equal parts may be found in populations further away, the majority would have longer anterior portions in those same populations. The overall thinness of the ocular tubercle did not appear to correlate with geography. The majority of scorpions had a comparatively short and wide tubercle, but some populations in the northern part of the range had an occasional individual with a long and thin tubercle.

The pigment of the ocular tubercle was not as variable. Most populations only had scorpions with tubercles that were entirely pigmented. Occasionally, a scorpion in these populations would have pigment restricted to the areas around and between the median eyes. Population PIN consistently had scorpions with a tubercle that was entirely pigmented with an immaculate or nearly immaculate center stripe the length of the tubercle for both males and females. This variant also appeared in one scorpion in population BCN, though nowhere else (Fig. 2).

***Pectinal Tooth Count***

The pectinal tooth count on each pectine comb was recorded for each population. They were reported as range, mean, and mode. Males and females were reported separately (Fig. 2; Table 9).

The overall pectinal tooth count for *A. p. pococki* is 5 to 10 in males (n=515 combs). While ranges heavily overlap, there is a geographic pattern where some areas have higher or lower counts than others, indicated by reported means and modes (Figs. 12-13). By visual inspection of maps, populations in the San Bernardino Mountains, Los Angeles County, Orange County, and western Riverside County trend towards having higher means and modes than the other populations. In these populations, means are greater than 8 and modes range from 8 to 10. The coastal populations in San Diego County have smaller means and modes. They also tend to have ranges only covering the lower end of the overlap. Here, means are less than 8 and modes range from 7 to 8. In the extreme southern part of San Diego County, mean pectinal tooth counts rise again, but the range remains mostly restricted to the lower end of the overall range for *A. p. pococki*. These areas of interest were the same areas that the populations with significant discrimination had in the DFA. But while there are apparent geographic differences, the large overlap between populations prevent pectinal tooth count from being a diagnostic character in males.

The overall pectinal tooth count for *A. p. pococki* females is 5 to 9 (n=236 combs) with most combs having 6 or 7 teeth. There are no apparent geographic differences in female pectinal tooth counts. The counts also heavily overlap with counts for males though the range is not quite as large and males more often have 8 or 9 teeth on a comb. Pectinal tooth counts are not diagnostic in females.

***Trichobothria***

*Pedipalp chela ventroexternal carina.* The trichobothrial count along the pedipalp chela ventroexternal carina was recorded for each population. They were reported as range, mean, and mode. Males and females were reported separately although sexual dimorphism in trichobothrial counts was not apparent (Fig. 2; Table 10), but males had some geographic differences, with some regions having larger or smaller means and modes (Figs. 14-15). The overall trichobothria count on the pedipalp chela ventroexternal carina in *A. p. pococki* for males + females was 13 to 27 (n=750 chela). By visual inspection of maps, Los Angeles County, inland populations in Orange County, and western Riverside County had counts in the higher reaches of the overall range as well as higher means and modes. Coastal San Diego and Baja California Norte had smaller means and modes with counts not reaching the upper limits of the range. These regions include the populations statistically separated in the DFA. Females did not exhibit any geographic differences. While these geographic patterns in males exist, so does heavy overlap in count ranges. These measurements are statistically useful but not strongly diagnostic within the *A. p. pococki* range.

*Pedipalp patella ventroexternal carina and "wrap around".* The trichobothrial count along the pedipalp patella ventroexternal carina and the "wrap around" arc on the external face were recorded for each population. Males and females were reported separately although no sexual dimorphism in counts was apparent. The trichobothria on the carina and the "wrap around" external arc were reported separately (Fig.2; Tables 11-12). The range of *A. p. pococki* for the ventroexternal trichobothria for males + females was 10 to 18. Through visual inspection of maps, it was determined that males exhibited some geographic differences with Los Angeles County, northern Orange County, and western Riverside having slightly higher means of the ventroexternal trichobothria than the rest of the range. Some of these populations are in close proximity to populations that statistically discriminated in the DFA. Populations TJE and BCN had unusually lower ranges, means, and modes (Figs. 16-17).

The "wrap around" trichobothria occur in an arc on the distal face of the pedipalp patella, starting from the ventroexternal carina. They intersect areas containing the *et* and *est* trichobothrial groups. By visually inspecting maps, males had some geographic variation (Figs. 18-19). The range of *A. p. pococki* for the "wrap around" trichobothria in males + females was 4 to 10. Los Angeles County, Orange County, and western Riverside County had larger means though modes were not as dissimilar to other regions. Northern Orange County had the largest means and this region contains a population that was found to be statistically discriminated in the DFA.

### *Interocular granulation*

Interocular granulation was highly variable within populations. Granulation pattern was recorded as smooth (i.e., essentially no granulation) or lightly, moderately, or heavily granulated. Sexually mature males and females were evaluated and reported separately because of the presence of sexual dimorphism.

Males had interocular areas ranging from smooth to heavily granulated. Most populations had males at every end of the range in granulation with some exceptions (Fig. 2, Figs. 20). Population ANZ only had males that were lightly granulated, although only two males were available from this population. Populations SUN and SBM had a larger number of males and exhibited the same trend as ANZ. Population MNT only had males with heavy granulation.

Females mostly ranged from smooth to moderately granulated, though some populations had females with more extensive granulation. Populations TOR, TEN, RAT, BKR, DIB, VEN, and CV2 had females with heavy granulation, but these were not common and there is no clear geographic correlation.

### *Mensuration*

The chela length/chela width ratio appears to be the most variable measurement among the range (Fig. 2, Figs. 21). This is supported by the chela measurements having the most discriminatory power in the DFA. Even so, the only oddities that exist in a non-multivariate context are populations in and near the San Gabriel Mountains and San Bernardino Mountains, being mostly restricted to the upper end of the range and populations in northern Orange County being restricted to the lower end.

After the DFAs were performed, the discriminating variables were examined between populations in single variable context (Table 13). The population in northern Orange County and western San Diego County were the populations E and A, respectively, in the DFAs. These two populations can sufficiently be diagnosed from each other using chela length/width, chela length/depth, and, to an extent, metasoma V length/width. Population A could be diagnosed from population L based on the ratio of telson length/telson vesicle width. The difficulty with populations A and L is that L is a sample size of 3 and additional measurements could increase the range and so should be interpreted with caution. Population E could be diagnosed from population L based on the ratios chela length/width, chela length/depth, metasoma V width/telson vesicle width, and telson length/telson vesicle width. But when compared to the rest of the populations in the *A. p. pococki* range, populations A and E could not be diagnosed separately from them based on morphometrics alone. Population L could be diagnosed from the other populations (sans A and E) by the ratio of telson length/telson vesicle width. Caution should be used since the sample size from L was small compared to A and E. While the DFAs have shown that A, E, and potentially L are statistically different on a multivariate level, diagnosability remains difficult due to larger overlap in morphometric ranges.

The most noticeable variation in *A. p. pococki* is the total size (Fig. 22). The total body length range is 39.53-74.38 mm in males and 42.83-72.10 mm in females. Southern populations tend to be small to medium-sized scorpions (39.53-56.70 mm in males; 42.83-56.30 mm in females) with the Los Angeles County and northern Orange County areas having large scorpions (63.68-74.38 mm in males; 62.90-72.10 mm in females).

### *Other Characters*

Several other characters were evaluated that contained too much variation with no geographic correlation to be useful. The setal counts on the carinae of the metasoma did not exhibit any geographic correlation in pattern though some populations appeared to have a higher frequency of scorpions with accessory setae between carinae than others. The tarsal spinules on legs I-IV also didn't differ significantly between *A. p. pococki* populations. The location of the setae on the telotarsi was so highly varied that no geographic pattern could be ascertained.

One of the characters reevaluated from Soleglad and Fet (2004) was the granulation of the pedipalp chela ventroexternal carina. *Anuroctonus pococki pococki* and *A. p. bajae* were diagnosed by the development of the carina being pitted/granular or a smooth ridge. When examined in visible light, both *A. p. pococki* and *A. p. bajae* would have a pitted carina. This character failed to diagnose a large number of specimens examined in visible light. When examined under UV light, both species have a smooth, granular, or pitted carina not correlated with a specific population. Some of these individuals appeared to have a pitted or granulated carina but the same carina appeared smooth under UV light. The variability in development also occurs in the digital carina. Scorpions from the same series could have either a granular or smooth ridge. Given that there is intrapopulation structural variability in multiple carinae, granulation of the pedipalp chela ventroexternal carina is not useful as a diagnostic character.

Infuscation of the telson and legs also had large intrapopulation variability. Population DMM in particular had a large range of fuscosity from absent to heavily infuscate for both legs and telson. Infuscation of legs and telson did not exhibit any geographic pattern nor was it useful for diagnosability.

Metasoma carination also varied from scorpion to scorpion. The dorsolateral, lateral inframedian, and ventral submedian carinae on metasoma IV were consistent throughout the *A. p. pococki* range. The other carinae on metasoma I-IV were usually structurally similar (crenulate) with few exceptions. The strength had high intrapopulation variability, ranging from weak to strong. Coarseness, measured by the number of crenulations, of these carinae were also evaluated. This character, too, was found to have high intrapopulation variability. On metasoma V, the dorsolateral, lateral, and ventrolateral carinae had low interpopulation variability. The ventromedian carina on metasoma V had high variability both in the strength of the carina and the number of granules. Carination was found to be non-diagnostic and no geographic pattern could be ascertained.

**Hybrids**

Soleglad and Fet (2004) identified localities Laguna Mountain, Banner Canyon, and Chariot Canyon as hybridized populations of *A. p. pococki* and *A. p. bajae*. After reevaluation of characters and additions of new ones, the scorpions in Laguna Mountain are assignable to *A. p. pococki* because of the infuscation on the digital carina. The only specimen in this study from Banner Canyon is a juvenile, and no specimens were available from Chariot Canyon. It is likely that these two populations will also be assignable to either *A. p. pococki* or *A. p. bajae* without the consideration of the invalid characters.

**Unassignable and Difficult Populations**

There were a few populations that were difficult to assign. The population PNC had series that contained specimens that were assignable to *A. p. pococki* as well as series that were assignable to *A. p. bajae*. This population occurs within a single mountain range, the San Jacinto Mountains, and where distributions of both species meet. This population either has both species occurring in the same localities or should be treated separately. This population was included in the discussion on variation and in the DFAs though in each the series that were assignable to *A. p. pococki* and *A. p. bajae* were treated separately. The scorpions assigned to *A. p. pococki* in this population were also comparatively lighter in color though not pale.

The populations PIN and SGM were difficult for similar reasons. Specimens from both series were a pale yellow color whereas the rest of the *A. p. pococki* are not (Figs. 23-24). There is a question of faded color and few series were available for study. Population PIN had two series that were comparatively old, one of which was large and the other containing a single specimen. The large series was collected by Lucas (1962) and the other collected by Haradon. Both of these series contained scorpions that were pale yellow and had little infuscation. A third series of a single specimen that was collected in 2010 that resembled the typical yellow-brown form of *A. p. pococki* with dark infuscation on the digital carina. Several of the series for population SGM were collected by Richard Haradon. Haradon worked with Dr. Stanley Williams, who pioneered a new preservation method for scorpions utilizing a combination of formalin, isopropyl alcohol, and acetic acid (Williams 1968). When scorpions are preserved in ethanol alone, there is a general trend of darkening color over time. Williams (1968) proposed this preservation method because it was thought to better fix color in the specimens and better preserve internal organs. It is suspected that Haradon used the FAA method to preserve. Recent collecting in these areas would solve the ambiguity of color.

**Limitations and Improvements for Future Study**

There were several limitations of this study that can be improved upon for its continuation. One of the major problems were small sample sizes for the populations analyzed. Some populations only had older collections available for analysis. Poor preservation can alter the color of the cuticle and thus over time produce a color that is not the natural state (Williams 1968). Fresh sampling of these populations would allow for more accurate color analysis.

The sample sizes for the multivariate statistics used in this study were not ideal for the statistical analyses performed and only males were in sufficient numbers to attempt them. Some populations were also biased towards male collections and others towards females. Females overall were underrepresented for analysis that requires sexually mature individuals making geographic, statistical, and morphological analysis difficult. Fresh collection will also help to increase sample sizes for the analyzed populations. With a larger representation of mature females, the aforementioned analyses would be feasible. With an increase in male sampling, requirements of the size of the DFA groups would not be violated and the results would take a step closer to being confirmatory over exploratory. It would also allow for better evaluation of some of the smaller northern populations utilized in this study.

Williams (1966) stated that *Anuroctonus* had a strong habitat preference and that soil composition is a limiting factor since these scorpions construct permanent burrows. Soil also acts as a limiting factor in other scorpion groups such as soil hardness in *Opisthophthalmus* (Lamoral 1978). Preference for microhabitats has been found in another non-fossorial scorpion, *Centruroides vittatus* (McReynolds 2008). Different species of *Urodacus*, another burrowing scorpion genus, were found to have preference for certain habitats and burrow construction and were classified based on depth and shape of burrow and environmental features (e.g. under rocks, sandy coastal soil, etc.)(Koch 1978). Soil could be an explanation for potential geographic isolation from other demes and for an increase in variation due to different soil specificities in *Anuroctonus*. Examining soil type and composition for preference in *A. p. pococki* populations would be beneficial to the analysis. Other ecological factors that would also be worth examining includes elevation and, in the case of *A. p. bajae*, latitudinal variation (though larger sampling across the range of this species would be required).

In each population there is large overlap in meristics and morphometrics with adjacent populations. While geographic patterns existed, it was not enough to satisfy diagnosability. Genetic data could help resolve new species if they exist or determine if this is natural variation of a single species. If new species exist, knowing which populations were genetically divergent could possibly parse out the overall ranges reported for various characters and lessen the overlap. This also has the potential to make use of qualitative characters currently deemed non-diagnostic in this study. Molecular studies of the various populations of *Anuroctonus* are in progress (L. Prendini, personal communication, 2016).

### Taxonomic Conclusions

According to the phylogenetic species concept (sensu Wheeler and Platnick), diagnosability is the reason to recognize forms as separate species (Wheeler and Platnick 2000). A species is the smallest aggregate separated by a unique combination of character states (Wheeler and Platnick 2000). While this species concept does not rely on geography to determine species, it is at least useful to determine populations. Species, however, are determined by character transformation and distribution of character states without making assumptions about geography (Wheeler and Platnick 2000). This differs from similar species concepts because a distinction is made between a trait (non-uniformly distributed among semaphoronts, comparable individuals at particular life stages) and a character (uniformly distributed among semaphoronts (Wheeler and Platnick 2000).

Southern California is known for being high in biological diversity (Ricketts et al. 1999) which is evident in diverse ecoregions found in this region. The state can be divided into

13 different ecoregions, with southern California having several of them (Ricketts et al. 1999). Coastal southern California is one of the Mediterranean biomes, anecosystem known for high biodiversity, although this climate is comparatively new since it formed following the first glacial which occurred in the past million years. (Axelrod 1973, Raven and Axelrod 1978). Other factors of southern California's high diversity include the heterogeneity in geography as well as historic geographic barriers (Harrison 2013). A suture zone is defined as a geographic overlap between biotic assemblages (Remington 1968). The majority of North American mountain ranges, of which southern California has several, are suture zones in that they have contributed to species divergence (Harrison 2013). It was hypothesized that there is a large suture zone in southern California (Remington 1968, Swenson 2010). The Great Basin comparatively is not a Mediterranean biome, it is not as diverse in number of ecoregions, and suture zones are limited to the periphery (Remington 1968, Ricketts et al. 1999, Swenson 2010) Coastal southern California has also experienced high habitat fragmentation by anthropogenic events, rendering these ecoregions as critical or endangered in conservation status. Inland ecoregions of the southwest are comparatively stable (Harrison 2013). Fragmentation by both geographic barriers and anthropogenic activity can cause reduction in population size thus potentially altering frequency of alleles (i.e. genetic drift), reducing gene flow, and reducing heterozygosity in the population (Lowe et al. 2008). These factors have likely contributed to the high biological diversity and morphological divergence of *Anuroctonus* seen in southern California.

In considering the three nominal forms of *Anuroctonus*, enough evidence has accumulated to recognize *phaiodactylus*, *pococki*, and *bajae* as separate, diagnosable species. *Anuroctonus phaiodactylus* is comparatively homogenous through its range from western Utah to eastern California and is easily diagnosed from *A. pococki* and *A. bajae*. *Anuroctonus p. bajae* is less homogenous than *A. phaiodactylus* but more so than *A. p. pococki*. After evaluation of characters, both new and previously identified by Soleglad and Fet (2004), it would be prudent to elevate *A. p. bajae* to species level.

Unlike *A. phaiodactylus* and *A. bajae*, *A. pococki* exhibits large amounts of variation without strong diagnosability. It is possible that *A. pococki* is a complex of closely related sister species and it is possible that genetic data is required to resolve these issues. This study served as a preliminary evaluation of *Anuroctonus* with a focus on a study of variation in *A. pococki*.

### Genus *Anuroctonus* Pocock 1893

*Anuroctonus* Pocock, 1893b: 306, 309; type species by monotypy *Centrurus phaiodactylus* Wood 1863 [=*Anuroctonus phaiodactylus* (Wood 1863)].

*Oncocentrus* Thorell, 1895: 375; type species by monotypy *Centrurus phaiodactylus* Wood 1863 [=*Anuroctonus phaiodactylus* (Wood 1863)] (synonymized by Kraepelin 1899: 183).

**References:**

*Anuroctonus*: Kovařík, 1998c: 135. Soleglad & Fet, 2003a: 7, 28, 41-43, 50, 57, 67, 82, 85, figs. 116-117, tabs. 3-4, tabs. 8-9; Prendini & Wheeler, 2005: 448, 450, 472-479, tab. 3, tab. 5, tab. 10; Soleglad & Fet, 2005: 2, 8-9; Fet, Soleglad, & Brewer, 2006: 10-11.

**Distribution.** Mexico (Baja California) and western USA (Utah, Idaho, Nevada, California).

### *Anuroctonus phaiodactylus* Wood 1863

(Figs. 25-26)

*Centrurus phaiodactylus* Wood, 1863a: 111.

**Type Data.** Male holotype (USNM), taken from "Utah Territory", USA; deposited in The National Museum of Natural History, Smithsonian Institution, Washington D.C., USA (USNM S-4); not examined. Paratype of unknown sex (ANSP), taken from same locality as holotype; deposited in The Academy of Natural Sciences of Drexel University, Philadelphia, USA; not examined.

**Distribution.** *Anuroctonus phaiodactylus* is known from western USA (Utah: Beaver County, Box Elder County, Juab County, Millard County, Toole County, Utah County, Washington County; Idaho: Oneida County; Nevada: Churchill County, Clark County, Elko County, Esmeralda County, Lincoln County, Mineral County, Nye County, White Pine County; California: Inyo County, Kern County, San Bernardino County). (Fig. 26)

**References.** Owing to the splitting of the genus into multiple species without updating the synonymies (Soleglad and Fet 2004), full listings are given below.

*Centrurus phaiodactylus*: Wood, 1863a: 372 (original description).

*Uroctonus phaeodactylus*: Karsch, 1879b (part): 102, 103; Marx, 1890a: 91; Kraepelin, 1894 (part): 196-198.

*Anuroctonus phaeodactylus*: Kraepelin, 1899 (part): 183; Pocock, 1902b (part): 13-14; Cox, 1921: 13; Werner, 1934a (part): 284; Passmore, 1938: 94; Gertsch, 1958 (part): 14; Gertsch & Allred, 1965 (part): 11-12; Williams, 1966 (part): 420; Diaz Najera, 1970: 116; Johnson & Allred, 1972: 157; Stahnke, 1974b (part): 118, 127-129.

*Oncocentrus phaeodactylus*: Thorell, 1895: 375.

*Uroctonus phaiodactylus*: Banks, 1900a: 424.

*Anuroctonus phaiodactylus*: Ewing, 1928 (part): 14-15; Williams, 1971b: 78-79; Hjelle, 1972 (part): 5, 7-8; Anderson, 1975: 2-5, fig. 1-4, 7, 12, tab. 1; Williams, 1976 (part): 2; Kovařík, 1998c (part): 135; Soleglad & Fet, 2003a (part): 7, 28, 41-43, 50, 57, 67, 82, 85, fig. 82; Soleglad & Fet, 2004: 91-93, 99-103, fig. 2, fig. 7, fig. 17, fig. 27, fig. 34, figs. 41–42, fig. 46, fig. 48, table 2; Soleglad & Fet, 2005: 4; Soleglad & Fet, 2008: 3, 6, 26.

**Diagnosis.** *Anuroctonus phaiodactylus* has an overall color of pale yellow to yellow brown scorpion whereas *A. pococki* is yellow-brown to dark brown. *A. phaiodactylus* has an obsolete to weak unpigmented digital carina on the pedipalp chela whereas *A. pococki* has a digital carina that is well-developed and is lightly to heavily infuscate. *A. phaiodactylus* always has a smooth interocular area (sometimes with light distal granulation) in males and females whereas *A. pococki* usually has a lightly to heavily granulated interocular area. If the scorpion has a smooth interocular area but is reddish brown, it is *A. pococki*.

*Anuroctonus phaiodactylus* has an obsolete to weak digital carina that is always unpigmented whereas *A. bajae* has a well-developed digital carina that is usually unpigmented but sometimes has light infuscation associated with granules. *A. phaiodactylus* has a smooth interocular area (sometimes with light distal granulation) in males whereas *A. bajae* has a moderately to heavily granulated interocular area in males.

*Descriptive characters*. Leg color pale yellow. Pectinal tooth count for males 6-12 and females 5-9. Trichobothrial pattern Type C, with accessory trichobothria as follows: chela ventroexternal carina numbers 12-16.

FEMALES. Females differ from males by lacking the swollen bulb on the telson and genital papillae that are found in sexually mature males. Immature males resemble females. The number of females available for this study was much smaller than males so it is difficult to characterize them.

**Records. United States: California: *Inyo County*:** Owens Valley, E side, 8.5 mi. W White Mt. rd turnoff on Hwy 168, 20 Aug 1990 (S. Williams, V. Lee, J. Chinn, & G. Lowe), 7 adult males (CAS); 19.4-23.2 mi. E Hwy 168 on Death Valley Rd, 22 Aug 1990 (S.Williams, V. Lee, J. Chinn, & G. Lowe), 1 adult male (CAS); 20.8 mi. E Hwy 168 on Death Valley Rd, 22 Aug 1990 (S. Williams, V. Lee, J. Chinn, & G. Lowe), 2 adult males, 2 adult females (CAS); Inyo Nat'l Forest, White Mountain Dist., Batchelder

Spring, 7.9 mi. E junction Hwys 395 and 168, 5 Sept 1988, 1830m (S. C. Williams & V. F. Lee), 1 adult male, 1 subadult female (CAS); Inyo Nat'l Forest, White Mountain Dist., 8.6 mi. E junction Hwys 395 and 168, 5 Sept 1988, 1938m (S. C. Williams & V. F. Lee), 1 adult female (CAS); Inyo Nat'l Forest, Santa Rita Flat, 12.7 mi. NE Independence, 9 Sept 1988, 1940m (S. C. Williams & V. F. Lee), 1 adult male (CAS); Inyo Nat'l Forest, White Mountain Dist., 3.9-4.7 mi. S Schulman Grove, 4 Sept 1988, 2610m (S. C. Williams & V. F. Lee), 1 adult male, 5 subadult females, 2 juveniles (CAS); 6.1 mi. E Deep Springs on Hwy 158, 9-10 Sept 1968 (C. R. Smith & F. Ennik), 1 adult male (CAS); Inyo Mtns, 2 mi. W Cowhorn Valley, 10 May to 12 Aug 1981, 2134m (D. Giuliani), 1 adult male (CAS); White Mtns, 4 mi. S, ½ mi. W Schulman Grove, 16 Jul to 3 Nov 1983, 2469m (D. Giuliani), 1 adult male (CAS); 2.9 mi. E junction Hwys 395 and 168, 5 Sept 1988, 1220m (S. C. Williams & V. F. Lee), 1 adult male, 2 subadult females (CAS); White Mountain Dist., 10.8 mi. E junction Hwys 395 and 168, 5 Sept 1988, 2130m (S. C. Williams & V. F. Lee), 1 adult male (CAS); 22.5-23.2 mi. E Hwy 168 on Death Valley Rd, 22 Aug 1990 (S. Williams, V. Lee, J. Chinn, & G. Lowe), 1 adult male (CAS); Argus Range, Birchum Spring, 13 Apr to 30 Jun 1982, 1676m (D. Giuliani), 2 adult males (CAS); Inyo Mtns, NE end Cowhorn Valley, sand dunes, 12 Mar to 11 Sept 1988, 2042m (D. Giuliani), 1 adult male (CAS); Fish Lake Valley, 6 mi. S, 4 mi. E Oasis, 8 Apr to 24 Jun 1982, 1585m (D. Giuiani), 2 adult males (CAS); Saline Valley, Grapevine Canyon, 4 Jul to 26 Dec 1982, 1737m (D. Giuliani), 4 adult males, 1 adult female (CAS); 22.5 mi. E Hwy 168 on Death Valley Rd, 22 Aug 1990 (S. Williams, V. Lee, J. Chinn, & G. Lowe), 1 adult male (CAS); Inyo Mtns, 2 mi W Cowhorn Valley, 25

Apr to 5 Aug 1982, 2286m (D. Giuliani), 1 adult male (CAS); Saline Valley, Grapevine Canyon, 23 May to 23 Sept 1983, 1524m (D. Giuliani), 1 adult male (CAS); Inyo Nat'l Forest, 10.0-10.4 mi. NE Independence, Mazourka Canyon, 9 Sept 1988, 1670m (S. C. Williams & V. F. Lee), 1 adult male (CAS); Inyo Mtns, Whippoorwill Canyon, 5 May to 13 Aug 1982, 1890m (D. Giuliani), 1 adult male (CAS); Argus Range, Birchum Spring, 8 Sept 1982 to 13 Jul 1983, 1676m (D. Giuliani), 2 adult males (CAS); Olancha, 18 Jul 1952 (M. Cazier, W. Gertsch, & R. Sohrammol), 2 adult males (CAS); ***Kern County*:** Walker Pass, along Rt 178, 3.2 mi. E of Walker Summit, 5 Aug 1972, 561.4m (R. Haradon & J. Marks), 15 adult males (CAS); SE of Walker Pass, NE side of SR-178/Walker Pass Rd (35.6434833°, -117.9856361°), 5 Aug 2008, 1369m (Z. J. Valois & W. Savary), 10 adult males (AMNH); Walker Pass Campground (35.6643889°, -118.0374167°), 13 Sept 2007, 1538m (L. Prendini & J. Huff), 12 adult females, 1 subadult female, 1 juvenile (AMNH); E of Onyx, S side of SR-178/Walker Pass Rd (35.7204111°, -118.1706417°), 5 Aug 2008, 865m (Z. J. Valois & W. Savary), 1 adult male (AMNH); E of Onyx, S side of SR-178/Walker Pass Rd (35.6953194°, -118.2172917°), 5 Aug 2008, 843m (Z. J. Valois & W. Savary), 1 adult male (AMNH); ***San Bernardino County*:** Clark Mt., 15 May 1971 (R. Haradon & R. Leutcke), 2 adult males, 4 adult female, 1 subadult male, 2 juveniles; Clark Mt., 15 May 1971 (R. M. Haradon & R. V. Leutcke), 1 adult male, 1 subadult female (CAS); Essex, 12 Aug 1956 (No Coll.; Stahnke Collection), 1 adult male (CAS); Providence Mtns, vicinity of Vulcan Mine, 16 May 1971 (R. Haradon & R. Leutcke), 2 adult females, 1 subadult female, 4 juveniles (CAS); Providence Mtns, vicinity of Vulcan Mine, 16 May 1971 (R. Haradon &

L. Leutcke), 1 adult male (CAS); Halloran Summit, N side of Rt 15, 1 Jul 1972 (R. M. Haradon & J. L. Marks), 3 adult males, 2 adult females, 2 subadult females (CAS); China Lake, Oct 1964 (D. Tieman), 1 adult male (CAS); Barstow, 24 Nov 1971 (L. Hunter), 1adult female (CAS); Barstow, 6 Oct 1971 (L. Hunter), 1 adult male (CAS); Barstow, 8 Sept 1989 (W. Costa), 1 adult male (CAS); **Nevada: *Churchill County*:** 20 mi. S Fallon, sand dunes, 26 Feb 1973 (D. Giuliani), 1 adult female, 7 juveniles (CAS); ***Clark County*:** 8.2 mi. NE junction Deer Creek and Hwy 52, Charleston Peak, 28 Aug 1965 (V. F. Lee), 1 adult male (CAS); Sandy Valley, 21 Aug 1983 (D. Glover), 1 adult male (CAS); Mountain Springs Summit, 20 Jul 1962, 1674m (R. C. Bechtel & F. D. Parker), 1 adult male (CAS); Toiyabe Nat'l Forest, Spring Mtns, 0-3.7 mi. NW of Hwy 156, on Macks Canyon Rd, 14 Aug 1991, 2270-2390m (S. C. Williams, V. F. Lee, & R. C. Bechtel), 1 adult male (CAS); Christmas Tree Pass, 13 Jun 1989 (R. C. Bechtel, J. L. Carpenter, & J. B Knight), 1 adult female (CAS); 8.7 mi. SW Hwy 95 on Hwy 156, on eastern slopes of Spring Mtns, 14 Aug 1991, 1800m (S. C. Williams, V. F. Lee, & R. C. Bechtel), 1 adult female (CAS); Mesquite Valley Sand Dunes (35.7583333°, -115.5833333°), 18 Aug 1999, 914.4m (R. C. Bechtel & F. D. Parker), 8 adult males, 4 adult females, 1 juvenile (CAS); Las Vegas, 1 Jun 1971 (N. Brown), 1 adult male (CAS); Las Vegas, 1 Jun 1971 (N. Brown), 1 adult male (CAS); Las Vegas, 1 Jun 1971 (N. Brown), 1 adult male (CAS); Las Vegas, 1 Jun 1971 (N. Brown), 1 adult male (CAS); ***Elko County*:** 18.9 mi. SW West Wendover, 24 Aug 1989, 1570m (S. C. Williams, V. F. Lee, R. C. Bechtel, & J. S. Chinn), 1 adult female (CAS); 20.2 mi. S West Wendover, 5 Aug 1994, 1460m (S. C. Williams & R. C. Bechtel), 3 adult males, 2 adult females (CAS); 1 mi. W West

Wendover, 5 Aug 1994, 1524m (S. C. Williams & R. C. Bechtel), 7 adult males, 1 adult female, 1 juvenile (CAS); 2 mi. W West Wendover, 5 Aug 1994, 1500m (S. C. Williams & R. C. Bechtel), 7 adult males, 2 adult females (CAS); ***Esmeralda County*****:** Silver Peak Range, Apache Tears area at summit W of Clayton Valley Dunes (37.6516667°, -117.795°), 16 Aug 1998, 1940m (R. C. Bechtel & F. D. Parker), 30 adult males, 1 adult female, 2 subadult females, 1 juvenile male, 2 juvenile females; 2 mi. SW of Blair Junction, 17 Oct 1991, 1460m (R. C. Bechtel), 1 adult female, 2 juveniles (CAS); Leidy Creek, 4.3 mi. N Dyer, 3.9 mi. W Hwy 264, 9 Aug 1991, 1870m (S. C. Williams, V. F. Lee, & R. C. Bechtel), 59 adult males, 2 adult females, 3 juveniles (CAS); ***Lincoln County*****:** Tule Desert, garden wash, 17 Jul 1984 (R. C. Bechtel & S. A. Steffen), 1 adult male, 1 subadult female (CAS); Sand Valley, 5 mi. WNW Tempiute, 21 Apr 1976 (D. Giuliani), 1 adult female (CAS); Spring Valley St. Park, 5.6 mi. SW Ursine, 16 Aug 1990, 1800-1900m (S. Williams, V. Lee, R. Bechtel, J. Chinn, & G. Lowe), 1 adult male, 1 subadult female (CAS); Hwy 93, 4.1 mi. ENE junction Hwys 93x138x375, 6 Oct 1989 (R. C. Bechtel), 1 adult male (CAS); Cathedral Gorge St. Park, 2 Sept 1988, 1460m (S. C. Williams, V. F. Lee, & R. C. Bechtel), 1 adult male (CAS); 11.6 mi. WSW Bristol Well, slopes on W side of Coyote Wash, 15 Aug 1990, 1600m (S. Williams, V. Lee, R. Bechtel, J. Chinn, & G. Lowe), 7 adult males (CAS); ***Mineral County*****:** 5 mi. N Mina, sand dunes, 8 Jan 1973 (D. Giuliani), 2 juveniles (CAS); 8 mi. S Mina, sand dunes, 27 Feb 1973 (D. Giuliani), 1 subadult female (CAS); ***Nye County*****:** Grapevine Mtns, Phinney Canyon, 18 Jul to 31 Aug 1982, 1707m (D. Giuliani), 2 adult males (CAS); Grapevine Mtns, Phinney Canyon, 16 Mar to 26 Aug 1983, 1707m (D. Giuliani), 2 adult males

(CAS); Rock Valley, 17 Sept 1964 (E. F. Dailey), 1 adult male (CAS); Rock Valley, no collection date, det. 1971 (D. B. Thomas), 2 adult males (CAS); Monitor Summit, 3 mi. N, 17 mi. E Tonopah, 28 Mar to 1 Oct 1992, 1951m (D. Giuliani), 1 adult male, 1 adult female, 1 juvenile (CAS); Monitor Summit, 3 mi. N, 17 mi. E Tonpah, Mar to Sept 1983, 1951m (D. Giuliani), 4 adult males (CAS); Stonewall Mtn, w slope, 8 mi. NE Stonewall Jct, 4 Aug 1955, 1631m (B. H. Bauta), 1 adult male (CAS); Black Rock Summit, 22 mi. N, 24 mi. E Warm Springs, Oct 1982 to Mar 1983, 1905m (D. Giuliani), 1 adult male (CAS); 7.4 mi. SW Belmont, 12 Aug 1990, 2000m (S. Williams, V. Lee, R. Bechtel, & J. Chinn), 1 adult female (CAS); Ralston Valley, 12 mi. E Tonopah, Mar 1984, 1676m (D. Giuliani), 2 adult males (CAS); Nr. Indian Well, appx. 14 mi. SSE Gabbs on Poleline Rd to Tonopah (38.695°, -117.8783333°), 20 Aug 1998, 1566m (R. C. Bechtel & F. D. Parker), 15 adult males (CAS); E face Toiyabe Mts., Bowman Creek, 8 Jun 1973, 2012m (S. Szerlip), 10 adult males, 1 juvenile (CAS); ***White Pine County*****:** 4 mi. W Baker, 4 mi. E campground, 1 Jul 1969, 1859m (Cazier et al.), 5 adult males (WDS); White River Valley, Jake’s Wash 20 mi. ESE Ely, Mar 1984 to Sept 1984, 1829m (D. Giuliani), 4 adult males (CAS); Snake Creek Canyon, 4.2 mi. S Baker, 2.2 mi. SW Hwy 486, 8 Aug 1994, 1680m (S. C. Williams, R. C Bechtel), 1 adult female, 1 juvenile (CAS); Snake Creek Canyon, 3.2-3.7 mi. SW Hwy 486, 4.2 mi. S Baker, 8 Aug 1994, 1770-1810m (S. C. Williams & R. C. Bechtel), 2 adult females (CAS); Snake Creek Canyon, 4.2 mi. SW Baker, 5.9-7.4 mi. SW Hwy 48, 8 Aug 1994, 2010-2470m (S. C. Williams & R. C Bechtel), 2 adult males, 3 adult females, 9 subadult females (CAS); **Utah:** ***Beaver County*****:** 10 mi. N, 30 mi. W Milford, Mar 1983 to Sept 1983 (D. Giuliani), 1 adult male, 1 adult female (CAS); 34.2 mi. WNW Milford, along Hwy 21, Wah Wah Mts. (38.505°, -113.5966667°), 26 Jul 2000, 1792m (S. C. Williams, V. F. Lee, & R. C. Bechtel), 30 adult males (CAS); ***Box Elder County*****:** Shore of Great Salt Lake, Promontory Point, 26 Aug 1946 (G. F. Knowlfer & C. V. Drake), 1 adult male (CAS); ***Juab County*****:** Little Sahara Rec. Area, Sand Mountain area, 7 Aug 1994, 1520m (S. C. Williams & R. C. Bechtel), 1 subadult female (CAS); Little Sahara Rec. Area, Jeracho camp area, 7 Aug 1994, 1540m (S. C. Williams & R. C. Bechtel), 1 adult male, 2 adult females (CAS); ***Millard County*****:** Sevier Lake, 22 mi. S, 33 mi. W Delta, Sept 1987 to Aug 1988 (D. Guiliani), 5 adult males (CAS); 3 mi. W of HW of Desert Exptl. Range, ca. 60 mi. SE Garrison, May 1994 (J. V. Zee), 4 adult males (WDS); 60 mi. SE Garrison, May 1994 (J. V. Zee), 1 adult male (WDS); ***Toole County*****:** 1 mi. W Delle, 6 Aug 1994, 1310m (S. C. Williams & R. C. Bechtel), 2 adult males, 2 adult females, 2 juveniles (CAS); 3 mi. W Grantsville, Aug 1970, 1585m (W. S. Brown), 1 adult male, 2 subadult females (CAS); Knolls, 6 Aug 1994, 1310m (S. C. Williams & R. C. Bechtel), 1 adult female, 2 subadult females, 2 juveniles (CAS)

**Spurious Records. USA: New Mexico:** ***San Juan County*****:** Ship Rock, Mar-Sept 1984, 1981m (D. Giuliani), 1 adult male (CAS).

*Discussion of spurious records*. This record is likely spurious due to the fact that it is highly disjunct from the closest recorded series available for this study (central Utah). For the purposes of this study, this specimen will be considered spurious.

## *Anuroctonus bajae* Soleglad and Fet 2004, new status

(Figs. 27-29; Table 14)

*Anuroctonus pococki bajae* Soleglad & Fet, 2004: 97-103, fig. 5, figs. 8–11, fig. 13, fig. 15, fig. 20, fig. 24, fig. 30,  fig. 36, figs. 39–40, figs. 44–45; table 4.

**Type Data.** Male holotype (CAS), 7 mi. E Ojos Negros, Baja California Norte, Mexico; desposited in The California Academy of Sciences, San Francisco, USA (Type No. 18437); not examined. Paratypes are four males and one female (CAS), collected from same locality as holotype; deposited in the California Academy of Sciences, San Francisco, USA.

**Distribution.** Mexico (Baja California: Ensenada, Mexicali, Tecate) and USA (California: Imperial County, San Bernardino County, San Diego County) (Fig. 29).

**References.** Owing to the splitting of the genus into multiple species without updating the synonymies (Soleglad and Fet 2004), full listings are given below.

*Uroctonus phaeodactylus*: Karsch, 1879b (part): 102, 103; Kraepelin, 1894 (part): 196-198.

*Anuroctonus phaeodactylus*: Kraepelin, 1899 (part): 183; Pocock, 1902b (part): 13-14; Hoffman, 1931 (part): 404-405; Werner, 1934a (part): 284; Gertsch, 1958 (part): 14; Gertsch & Allred, 1965 (part): 11-12; Williams, 1966 (part): 420; Stahnke, 1974b (part): 118, 127-129

*Anuroctonus phaiodactylus*: Banks, 1910 (part): 188; Ewing, 1928 (part): 14-15; Hjelle, 1972 (part): 5, 7-8; Williams, 1976 (part): 2; Williams, 1980 (part): 14-15, fig. 14-16; Kovařík, 1998c (part): 135.

*Anuroctonus sp.*: Soleglad & Fet, 2003a (part): 7, 28, 41-43, 50, 57, 67, 82, 85, fig. 34, fig. 103.

*Anuroctonus pococki bajae* Soleglad & Fet, 2004: 97-103, fig. 5, figs. 8–11, fig. 13, fig. 15, fig. 20, fig. 24, fig. 30, fig. 36, figs. 39–40, figs. 44–45, table 4. (original description); Soleglad & Fet, 2005: 4; Fet, Soleglad, & Brewer, 2006: 3, 10-11; Soleglad & Fet, 2008: 3, 6, 26.

**Diagnosis.** *Anuroctonus bajae* has a well-developed digital carina on the pedipalp chela that is usually unpigmented (some may have light infuscation associated with granules) whereas *A. phaiodactylus* has an obsolete to weak digital carina that is always unpigmented. *Anuroctonus bajae* has a moderately to heavily granulated interocular area in males whereas *A. phaiodactylus* has a smooth interocular area (sometimes with light distal granulation).

*Anuroctonus bajae* is pale yellow to yellow-brown in overall color whereas *A. pococki* is yellow-brown to dark brown. *Anuroctonus bajae* has an unpigmented to lightly infuscate digital carina on the pedipalp chela whereas *A. pococki* has a digital carina that is lightly to heavily infuscate (some of whom have a non-contrasting carnina with the chela manus). If *A. bajae* has a lightly infuscate carnina, it is primarily associated with granules. *Anuroctonus bajae* has an ocular tubercle that has black pigment only associated with the median eyes whereas *A. pococki* has a tubercle that is usually entirely covered in black pigment. *Anuroctonus bajae* has a pedipalp femur length/width ratio of 2.17-3.07 in males whereas *A. pococki* has a ratio of 1.92-2.46. If ratio is 2.17-2.46 and the scorpion is reddish brown to dark brown, it is *A. pococki*. If legs in *A. bajae* are contrasting, they are not significantly different from body color whereas in *A. pococki* there is a high contrast between legs and body.

*Descriptive characters*. Small to medium-sized scorpion with a total body length of 41.58-55.15 mm (maximum as reported by Soleglad and Fet 2004) in males and 45.13-50.38 mm in females. Pectinal tooth count for males is 6-10 (mean=8.08, mode=8; n=81 combs) and females 5-8 (mean=6.42, mode=6; n=64 combs). Trichobothrial pattern Type C, with accessory trichobothria as follows: chela ventroexternal carina numbers 13-19 (mean=15.56, mode=15; n=35 chela); pedipalp patella ventroexternal carina numbers 10-15 (mean=12.38, mode=13; n=35 patella); pedipalp patella wrap around numbers 3-7 (mean=5.16, mode=6; n=35 patella).

In sexually mature males, morphometrics is as follows: chela length/width ratio is 2.88-2.56; chela length/depth ratio is 2.31-2.71; chela width depth ratio is 0.75-0.86; moveable finger length/chela width ratio is 1.62-2.05; fixed finger length/carapace length ratio is 0.61-0.83; fixed finger length/chela length is 0.39-0.69; metasoma I length/width is 0.71-0.85; metasoma V length/width is 2.82-3.45; carapace length/metasoma V length is 1.09-1.29; telson length/vesicle depth is 2.18-2.70; telson length/vesicle width is 2.17-2.64; metasoma V width/vesicle width 0.66-0.79; leg IV patella length/width is 2.19-2.88 (Table 14).

FEMALES. Females differ from males by lacking the swollen bulb on the telson and genital papillae that are found in sexually mature males. Immature males resemble females. The number of females available for this study was much smaller than males so it is difficult to characterize them.

**Records. Mexico: Baja California: *Ensenada*:** 7 mi. E Ojos Negros, 10 Jul 1969, 1067m (S. C. Williams & V. F. Lee), 3 paratype adult males, 1 paratype adult female, 1 paratype juvenile (CAS); 7 mi. E Ojos Negros, 1067m, 10 Jul 1969 (S. C. Williams & V. F. Lee), 1 topotype adult female, 1 topotype juvenile (CAS); Between Rancho Filipinas and Rancho Viejo, 30 Jun 1962 (W. Estavillo & D. Clites), 1 adult female (CAS); Santa Isabel, 45 mi. E Ensenada, 30 Jul 1962 (W. Estavillo & D. Clites), 1 adult male (CAS); Between Rancho Filipinas and Ranch Viejo, 30 Jun 1962 (W. Estavillo & D. Clites), 1 adult female (CAS); Sierra Juárez, 11 mi. SW Sawmill, 16 Jul 1969, 1585m (S. C. Williams & V. F. Lee), 1 adult female (CAS); Siera San Pedro Mártir, Mikes Sky Ranch, 14-15 Jun 1973 (S. C. Williams & K. B. Blair), 1 adult male (CAS); 22 mi. S San Vicente, 6 Apr 1969, 91m (S. C. Williams), 1 subadult female (CAS); Sierra Juárez, Laguna Hanson, 9 Jul 1969, 1676m (S. C. Williams & V. F. Lee), 3 adult males, 3 juveniles (CAS); ***Mexicali*:** Santa Isabel, 45 mi. E Ensenada, 30 Jun 1962 (W. Estavillo & D. Clites), 1 adult female (CAS); ***Tecate*:** Sierra Juárez, 6 mi. N Rancho El Topo, 16 Jul 1969, 1524m (S. C. Williams & V. F. Lee), 6 adult males (CAS); Sierra Juárez, 4 mi. N Rancho El Topo, 31 Mar 1969, 1372m (S. C. Williams), 2 adult males, 4 adult females, 5 subadult females, 3 juveniles (CAS); **USA: California: *Imperial County*:** Glamis, 20 Mar 1976 (E. L. Klee), 1 adult male (CAS); ***San Bernardino County*:** Covington Flats

(34.401492°, -116.31512°), USGS Field Station, pitfall trap array COV-9, 27 Jun 2000, 1501m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.03091°, -116.34881°), USGS Field Station, pitfall trap array COV-12, 21 Aug 2000, 1654m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.05661°, -116.32574°), USGS Field Station, pitfall trap array COV-3, 21 Sept 1999, 1364m (Coll. USGS), 1 subadult male, 1 subadult female (AMNH); Covington Flats (34.05661°, -116.32574°), USGS Field Station, pitfall trap array COV-3, 6 Jul 1999, 1364m (Coll. USGS), 2 adult males (AMNH); Covington Flats (34.0401°, -116.3099°), USGS Field Station, pitfall trap array COV-6, 6 Jul 1999, 1434m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.0183° -116.32003°), USGS Field Station, pitfall trap array COV-8, 4 Jun 2001, 1534m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.0401°, -16.3099°), USGS Field Station, pitfall trap array COV-6, 21 Aug 2000, 1434m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.0401°, -116.3099°), USGS Field Station, pitfall trap array COV-6, 4 Jun 2001 (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.02813°, -116.31777°), USGS Field Station, pitfall trap array COV-7, 4 Jun 2001, 1522m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.06301°, -116.3365°), USGS Field Station, pitfall trap array COV-2, 6 Jul 1999, 1327m (Coll. USGS), 2 adult males (AMNH); Covington Flats (34.02813°, -116.31777°), USGS Field Station, pitfall trap array COV-7, 27 Jun 2000, 1522m (Coll. USGS), 2 adult males (AMNH); Covington Flats (34.04089°, -116.31363), USGS Field Station, pitfall trap array COV-5, 21 Sept 1999, 1428m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.05661°, -116.32574°), USGS Field Station, pitfall trap array COV-3, 21 Aug 2000, 1364m (Coll. USGS), 1 adult male (AMNH);

Covington Flats (34.01492°, -116.31512°), USGS Field Station, pitfall trap array COV-9, 6 Jul 1999, 1501m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.05661° -116.32574°), USGS Field Station, pitfall trap array COV-3, 6 Jul 1999 to Jul 2001, 1364m (Coll. USGS), 1 juvenile female (AMNH); Covington Flats (34.03059°, -116.34737°), USGS Field Station, pitfall trap array COV-11, 27 Jun 2000, 1660m (Coll. USGS), 1 adult male (AMNH); Burns Reserve (34.14962°, -116.4523), pitfall trap array 1, 6 Jul to 16 Jul 1999 (Coll. USGS), 1 subadult female (DMNS); Covington Flats (34.01492°, -116.31512°), USGS Field Station, pitfall trap array COV-9, 6 Jul 1999, 1501m (Coll. USGS), 4 adult males (AMNH); Covington Flats (34.03059°, -116.34737°), USGS Field Station, pitfall trap array COV-11, 4 Jun 2001 1660m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.04089°, -116.31363°), USGS Field Station, pitfall trap array COV-5, 21 Aug 2000, 1428m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.06841°, -116.34154°), USGS Field Station, pitfall trap array COV-1, 6 Jul 1999 to Jul 2001, 1309m (Coll. USGS), 1 juvenile (AMNH); Covington Flats (34.0183°, -116.32003°), USGS Field Station, pitfall trap array COV-8, 21 Aug 2000, 1534m (Coll. USGS), 1 subadult female (AMNH); Covington Flats (34.01492°, -116. 31512°), USGS Field Station, pitfall trap array COV-9, 16 Apr 2000, 1501m (Coll. USGS), 1 adult female (AMNH); Covington Flats (34.03091°, -116.34881°), USGS Field Station, pitfall trap array COV-12, 6 Jul 1999 to Jul 2001, 1654m (Coll. USGS), 2 adult males (AMNH); Covington Flats (34.0183°, -116.32003°), USGS Field Station, pitfall trap array COV-8, 6 Jul 1999 to Jul 2001, 1534m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.03091°, -116.34881°), USGS Field

Station, pitfall trap array COV-12, 4 Jun 2001, 1654m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.06301°, -116.3365°), USGS Field Station, pitfall trap array COV-2, 16 Apr 2000, 1327m (Coll. USGS), 1 juvenile (AMNH); Covington Flats (34.03091°, -116.34881°), USGS Field Station, pitfall trap array COV-12, 27 Jun 2000, 1654m (Coll. USGS), 1 adult male, 1 juvenile (AMNH); Covington Flats (34.026°, -116.33915°), USGS Field Station, pitfall trap array COV-10, 6 Jul 1999, 1567m (Coll. USGS), 4 adult males (AMNH); Burns Reserve (34.14783°, -116.45299°), USGS Field Station, pitfall trap array BUR-2, Jul 2001 (Coll. USGS), 1 subadult female (AMNH); Burns Reserve (34.14512°, -116.45156°), USGS Field Station, pitfall trap array BUR-6, Oct 1999 (Coll. USGS), 1 adult male (AMNH); Burns Reserve (34.14962°, -116.4523°),USGS Field Station, pitfall trap array BUR-1, Jul 2000 (Coll. USGS), 1 adult male (AMNH); Burns Reserve (34.14962°, -116.4523°), pitfall trap array 1, 1 Jul to 11 Jul 2001 (Coll. USGS), 1 adult male (DMNS); Burns Reserve (34.14783°, -116.45299°), USGS Field Station, pitfall trap array BUR-2, Jul 1999 (Coll. USGS), 1 subadult female (AMNH); Burns Reserve (34.1468°, -116.45359°), USGS Field Station, pitfall trap array BUR-4, Jul 1999 (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Monument (34.01081°, -116.09223°), USGS Field Station, pitfall trap array JOS-13, 31 Jul 2000, 1342m (Coll. USGS), 1 adult male (AMNH); Covington Flats (34.0183°, -116.32003°), USGS Field Station, pitfall trap array COV-8, 27 Jun 2000, 1534m (Coll. USGS), 2 adult males (AMNH); Joshua Tree Nat'l Monument (34.05278°, -116.21563°), USGS Field Station, pitfall trap array JOS-19, 31 Jul 2000, 1180m (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Monument (33.92586°, -116.17824°), USGS Field

Station, pitfall trap array JOS-17, Jul 2001, 1551m (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Monument (34.00351°, -116.11681°), USGS Field Station, pitfall trap array JOS-14, 26 Oct 1999, 1366m (Coll. USGS), 1 male (AMNH); Joshua Tree Nat'l Monument (34.01081°, -116.0923°), USGS Field Station, pitfall trap array JOS-13, 12 Aug 1999, 1342m (Coll. USGS), 2 adult males (AMNH); Joshua Tree Nat'l Monument (34.00351°, -116.11681°), USGS Field Station, pitfall trap array JOS-14, 12 Aug 1999, 1366m (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Monument (34.00351°, -116.11681°), USGS Field Station, pitfall trap array JOS-14, 14 Apr 1999, 1366m (Coll. USGS), 1 juvenile male (AMNH); Joshua Tree Nat'l Monument (33.92586°, -116.17824°), USGS Field Station, pitfall trap array JOS-17, 12 Aug 1999, 1551m (Coll. USGS), 2 adult males (AMNH); Joshua Tree Nat'l Monument (34.05278° -116.21563°), USGS Field Station, pitfall trap array JOS-19, 12 Aug 1999, 1180m (Coll. USGS), 2 adult males (AMNH); Joshua Tree Nat'l Monument (34.01081°, -116.09223°), USGS Field Station, pitfall trap array JOS-13, Jul 2001, 1342m (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Park, 0.16 mi. S of Hidden Valley Campground (34.0137333°, -116.1599611°), 8 May 2008, 1278m (Z. J. Valois & B. Hendrixson), 2 adult females (AMNH); Joshua Tree Nat'l Monument (33.92586°, -116.17824°), USGS Field Station, pitfall trap array JOS-17, 17 May 2000, 1551m (Coll. USGS), 1 adult male (AMNH); Joshua Tree Nat'l Monument (34.05278°, -116.21563°), USGS Field Station, pitfall trap array JOS-19, 26 Oct 1999, 1180m (Coll. USGS), 1 specimen with damage too extensive to determine age or sex (AMNH); Joshua Tree Nat'l Monument (34.05278°, -116.21563°), USGS Field Station, pitfall trap array JOS-19, 12 Aug 1999, 1180m (Coll. USGS), 1 adult male, 1 adult female (AMNH); Joshua Tree Nat'l Monument, Indian Cove campground, site #2, 30 Mar 1969, 975m (V. F. Lee & J. Booker), 4 adult males, 1 juvenile (CAS); San Bernardino Mts, along Road 3NO3, 9 mi. W of Rimrock, 3 Jul 1971 (R. Haradon & J. Marks), 2 adult males (CAS); San Bernardino Mts, along Road 3NO3, 9.4 mi. W of Rimrock, 3 Jul 1972 (R. Haradon & J. Marks), 6 adult males, 1 subadult female (CAS); Silverwood Lake Recreation Area (34.27157°, -117.29597°), USGS Field Station, pitfall trap array SIL-11, 22 Aug 2001, 1100m (Coll. USGS), 1 adult male (AMNH); Along W slope of Rt 62, 0.6m S of Morongo Valley, 14 Feb 1971 (R. M. Haradon & J. Marks), 1 adult male, 2 adult females, 1 juvenile (CAS); Yucca Valley, along the W slope of Rt 62 at the S edge of town, 14 Feb 1971 (R. M. Haradon & J. Marks), 1 adult male (CAS); San Bernardino Mts., along Rt 38, 0.9 mi. S Onyx Summit, 2 Jul 1972 (R. Haradon & J. Marks), 8 adult males, 3 adult females, 1 subadult male, 3 subadult females; San Bernardino Mts., along road 3NO3, 4.6 mi. E Jct Rt. 38 at Big Bear City, 2 Jul 1972 (R. M. Haradon & J. L. Marks), 6 adult males, 1 adult female (CAS); ***San Diego County*:** Jacumba, just W of town on Olde Hwy 80, close to USA/Mexico border (32.61645°, -116.2130333°), Site 9, 15 Sept 2012, 924m (L. Prendini & W. E. Savary), 3 adult males, 5 adult females, 1 juvenile male (AMNH).

## *Anuroctonus pococki* Soleglad and Fet 2004, new status

(Figs. 30-31; Table 14)

*Anuroctonus pococki pococki* Soleglad & Fet, 2004: 93-96, 99-103, fig. 21, fig. 25, fig. 29, fig. 35, fig. 38, fig. 43, table 3.

**Type Data.** Male holotype (CAS), 1 mi. N Santee, San Diego county, California, USA; desposited in The California Academy of Sciences, San Francisco, USA (Type No. 18436). Paratypes are two series containing one male (MES) and a series of male and female juveniles (MES), all collected from same locality as holotype; all deposited in the personal collection of Michael E. Soleglad.

**Distribution.** Mexica (Baja California: Ensenada, Playas de Rosalito, Tijuana) and USA (California: Kern County, Los Angeles County, Monterrey County, Orange County, Riverside County, San Benito County, San Bernardino County, San Diego County, San Luis Obispo County, Santa Barbara County, Tulare County, Ventura County) (Fig. 33).

**References.** Owing to the splitting of the genus into multiple species without updating the synonymies (Soleglad and Fet 2004), full listings are given below.

*Uroctonus phaeodactylus*: Karsch, 1879b (part): 102, 103; Kraepelin, 1894 (part): 196-198.

*Anuroctonus phaeodactylus*: Kraepelin, 1899 (part): 183; Pocock, 1902b (part): 13-14; Hoffman, 1931 (part): 404-405; Werner, 1934a (part): 284; Gertsch, 1958 (part): 14;

Gertsch & Allred, 1965 (part): 11-12; Williams, 1966 (part): 419-428; Stahnke, 1974b (part): 118, 127-129.

*Uroctonus phaiodactylus*: Banks, 1904: 365.

*Anuroctonus phaiodactylus*: Banks, 1910 (part): 188; Ewing, 1928 (part): 14-15; Hjelle, 1972 (part): 5, 7-8; Williams, 1976 (part): 2; Williams, 1980 (part): 14-15, fig. 14-16; Kovařík, 1998c (part): 135;

*Anuroctonus sp.*: Soleglad & Fet, 2003a (part): 7, 28, 41-43, 50, 57, 67, 82, 85, fig. 34, fig. 103.

*Anuroctonus pococki pococki*: Soleglad & Fet, 2004: 93-96, 99-103, fig. 21, fig. 25, fig. 29, fig. 35, fig. 38, fig. 43, table 3. (original description); Fet, Soleglad, & Brewer, 2006: 3, 10-11; Soleglad & Fet, 2008: 3, 6, 26.

**Diagnosis.** *Anuroctonus pococki* has an overall color of yellow-brown to dark brown whereas *A. phaiodactylus* is pale yellow to yellow-brown. *Anuroctonus pococki* has a well-developed digital carina on the pedipalp chela that is lightly to heavily infuscate whereas *A. phaiodactylus* has a digital carina that is obsolete to weak and unpigmented. *Anuroctonus pococki* usually has a lightly to heavily granulated interocular area in males and females whereas *A. phaiodactylus* always has a smooth interocular area (sometimes with light distal granulation). If the scorpion has a smooth interocular area but is reddish brown, it is *A. pococki*.

*Anuroctonus pococki* is yellow-brown to dark brown whereas *A. bajae* is pale yellow to yellow-brown in overall color. *A. pococki* has lightly to heavily infuscate digital carina (some of whom have carinae that are non-contrasting with the chela manus) whereas *A. bajae* has an unpigmented to lightly infuscate carina. If it is lightly infuscate in *A. bajae,* it is primarily associated with the granules. *A. pococki* has an ocular tubercle that is entirely pigmented black whereas *A. bajae* has pigment only associated with the median eyes. *A. pococki* has a pedipalp femur length/width ratio of 1.92-2.46 in males whereas *A. bajae* has a ratio of 2.17-3.07. If ratio is 2.17-2.46 and the scorpion is reddish brown to dark brown, it is *A. pococki*. If legs in *A. bajae* are contrasting, they are not significantly different from body color whereas in *A. pococki* there is a high contrast between legs and body.

*Descriptive characters*. Small to large scorpions with total body length of 39.53-74.38 mm in males and 42.83-72.10 mm in females. Overall color dark yellow brown to dark reddish brown in the rest of the range; two populations show pale yellow color. Pectinal tooth count 5-10 (mean=8.41, mode=8; n=491 combs) in males and 5-9 (mean=6.70, mode=7; n=240 combs) in females. Trichobothrial pattern Type C, with accessory trichobothria as follows: chela ventroexternal carina numbers 13-27 (mean=18.22, mode=18, n=754 chela); pedipalp patella ventroexternal carina numbers 10-18 (mean=13.34, mode=13, n=377 patella); pedipalp patella wrap around numbers 4-10 (mean=6.96, mode=7, n=370 patella).

In sexually mature males, morphometrics is as follows: chela length/width ratio is 2.57-3.24; chela length/depth ratio is 2.13-2.91; chela width/depth ratio is 0.75-0.95; moveable finger length/chela width ratio is 1.45-2.02; fixed finger length/carapace length ratio is 0.53-0.77; fixed finger length/chela length is 0.34-0.46; metasoma I length/width is 0.65-0.89; metasoma V length/width is 2.65-3.85; carapace length/metasoma V length is 0.98-1.44; telson length/vesicle depth is 1.93-2.57; telson length/vesicle width is 2.13-2.71; metasoma V width/vesicle width 0.61-0.83; leg IV patella length/width is 2.25-3.29 (Table 14).

FEMALES. Females differ from males by lacking the swollen bulb on the telson and genital papillae that are found in sexually mature males. Immature males resemble females. The number of females available for this study was much smaller than males so it is difficult to characterize them.

COMMENTS: It was difficult to match specimens to the holotype designated by Soleglad and Fet (2004). The specimen is in poor condition with broken tarsal spinules, setae, and trichobothria. The cuticle is also weak. The specimen is also pale yellow which matches no other specimen in geographic proximity that was examined in this study. It is possible that the specimen is a teneral adult, due to the weakened non-sclerotized cuticle that is typical after ecdysis (Gaban and Farley 2002), or is poorly preserved.

**Records. Mexico: Baja California: *Ensenada*:** Punta Banda, 10 Jul 1969, 31m (S. C. Williams & V. F. Lee), 2 adult males (CAS); Punta Banda, 29 Jul 1962 (H. M. Johnson), 1 adult male (CAS); Punta Banda, 5 Apr 1969, 31m (S. C. Williams), 1 adult female, 1 subadult female, 1 juvenile male (CAS); 12 mi. SE Maneandero, 19 Apr 1965 (D. Q. Cavagnaro, C. E. & E. S. Ross, & V. L. Vesterby); 2 adult males (CAS); 4 mi. NNE El Sauzal, 15 Jul 1969, 122m (S. C. Williams & V. F. Lee), 1 adult female (CAS); N Santo

Tomás, 9 Apr 1968 (Kilton & J. Tom), 3 adult males (CAS); 2 mi. SE of Eréndira, 12 May 1973 (S. C. Williams & K. B. Blair), 1 adult male (CAS); Hermatite Mine, 1.6 mi. N Punta Calaveras, 13 Jul 1962 (C. Parrish), 1 adult male (CAS); Sierra San Pedro Mártir, 5 mi. W Meling Ranch, 13 Jul 1969, 732m (S. C. Williams & V. F. Lee), 1 adult male (CAS); ***Tijuana*:** 31 mi. S of Tijuana, 13 Jul 1962 (C. Parrish), 1 adult male (CAS); **USA: California: *Kern County*:** 10 mi. NE E. Bakersfield off Hwy 178, near entrance to Sequoia Nat'l Forest, 28 Jun 1985 (S. A. Stockwell & S. W. Taber), 2 adult females (WDS); ***Los Angeles County*:** Puente Hills (33.96645°, -117.92143°), pitfall trap array 8, 22 Jun to 2 Jul 1998 (Coll. USGS), 1 adult female (DMNS); Puente Hills (33.99642°, -118.03513°), pitfall trap array 12, 24 Apr to 4 May 2000 (Coll. USGS), 1 adult male (DMNS); Puente Hills (33.96645°, -117.92143°), pitfall trap array 8, 25 Aug to 4 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Puente Hills (33.96645°, -117.92143°), pitfall trap array 8, 25 Aug to 4 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Puente Hills (33.96645°, -117.92143°), pitfall trap array 8, 7-17 Sept 1999 (Coll. USGS), 1 adult male (DMNS); Puente Hills (33.99642°, -118.03513°), pitfall trap array 12, 25 Aug to 3 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Angeles Nat'l Forest, 5.7 mi SW Warm Springs, 24 Mar 1967 (V. Lee), 1 male (CAS); Chatsworth, 17 Apr 1968 (K. Umphres), 1 male (CAS); Long Beach, Oct. 1959 (J. Lynn), 1 male (CAS); Long Beach, Sept 1958 (J. Lynn), 1 male (CAS); Los Angeles, 21 Aug 1941 (no collector), 1 male (CAS); Los Angeles, Nov-Dec 1922 (no collector), 1 male (CAS); Pomona, 21 Sept 1964 (F. Russell), 1 female (CAS); Rose Hills, 31 Mar 1974 (P. Thomsen), 1 female (CAS); San Dimas Canyon, nr. Claremont, 2 Sept 1956 (no collector), 1 male (CAS); Santa Monica

Mts., Las Flores Canyon, along Las Flores Canyon Rd., 0.8-1.2 mi above jct. State Rd. 1, 3 Mar 1972 (R. Haradon, J. Marks), 1 male, 1 female (CAS); Santa Monica Mts., along Kimberly Canyon Rd. 2.3 mi N jct. Mulholland Hwy, 17 Aug 1971 (R.Haradon), 1 male (CAS); Santa Monica Mts., along Encinal Canyon Rd., 1.0 mi S jct. Mulholland Hwy, 19 Aug 1971 (R. Haradon), 2 males (CAS); Santa Monica Mts., along Encinal Canyon Rd., 2.9 mi S jct. Mulholland Hwy, 19 Aug 1971 (R. Haradon), 1 male (CAS); Santa Monica Mts., along Little Sycamore Canyon Rd., 2.9 mi N jct Mulholland Hwy, 16 Aug 1971 (R. Haradon, J. Marks), 2 males (CAS); Santa Monica Mts., Pacific Palisades, Trailer Canyon, approx. 200 yards above limestone quarry, 17 Jan 1971 (R. Haradon), 1 male, 1 female, 4 sub females, 2 juvs. (CAS); Santa Monica, along Potrero Rd., nr. High Valley Ranch, 0.3 mi above jct. Hidden Valley Rd., 4 Mar 1972 (R. Haradon, J. Marks), 1 male (CAS); Santa Monica, 1 Jan 1971 (R. Haradon), 1 female (CAS); vicinity of Little Rock Dam, just below dam along Cheseboro Rd., 27 Sept 1970 (R. Haradon, R. Howard), 1 sub female (CAS); vicinity of Little Rock Dam, 3.0 mi E jct. Rt. 138 and Cheseboro Rd, along Cheseboro Rd., 9 Jan 1971 (R. Haradon, J. Marks), 1 male, 1 female, 1 sub male, 1 juv female (CAS); ***Monterrey County*****:** Paloma Canyon, 40 mi from Monterey, 25 Dec 1963 (R. Johnson), 2 males (CAS); 5 mi S Jolan, 8 Apr 1970 (F. Ennik), 1 female (CAS); Monterey, 15 June 1965 (R. Johnson), 1 male (CAS); just S of Monterey, 8 Apr 1972 (R. Johnson), 1 male, 1 female (CAS); Gonzales, 24 June 1963 (R. Johnson), 1 female (CAS); Hastings Natural History Reserve, 36°22’N: 121°33’W, 11 June 1938 (J. Linsdale), 1 female (CAS); Hastings Natural History Reserve, 36°22’N: 121°33’W, 20 July 1942 (J. Linsdale), 1 male (CAS); Los Padres Nat’l. Forest, 4 mi SE Nacimiento

Summit Campgd, 8 Aug 1970 (W. Azevedo, V. Lee), 1 male (CAS); ***Orange County*****:** Dana Point, along Selva Rd. at jct. of street of Golden Lantern, 12 Feb 1972 (R. Haradon, J.Marks), 1 female, 1 juv (CAS); Laguna Beach, Dec. 1993 (L. Vincent), 1 male, 1 female (CAS); Irvine Ranch Conservancy Preserve, former USGS pitfall trap sites (33.6980722°, -117.6821944°), 230m, 2 Aug 2008 (Z. J. Valois & W. E. Savary), 1 adult male (AMNH); Limestone Canyon (33.72311°, -117.66637°), USGS Field Station, pitfall trap array LIM-9, 3 Feb 2002, 400m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.71872°, -117.6606°), USGS Field Station, pitfall trap array LIM-5, 19 Jul 1997-Mar 2006, 431m (Coll. USGS), 1 adult female (AMNH); Limestone Canyon (33.73606°, -117.67048°), USGS Field Station, pitfall trap array LIM-12, 23 Jul 2001 (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.722°, -117.66579°), USGS Field Station, pitfall trap array LIM-7, 23 Jul 2001, 387m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.722°, -117.66579°), USGS Field Station, pitfall trap array LIM-7, 19 Jul 1997, 387m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73686°, -117.69222°), USGS Field Station, pitfall trap array LIM-8, 18 Dec 2001, 448m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.71834°, -117.67125°), USGS Field Station, pitfall trap array LIM-10, 24 Aug 1998, 405m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73686°, -117.69222°), USGS Field Station, pitfall trap array LIM-10, 24 Aug 1998, 405m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73686°, -117.69222°), USGS Field Station, pitfall trap array LIM-8, 448m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73373°, -117.67053°), USGS Field Station, pitfall trap array LIM-11, 26 Mar 2002, 338m

(Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.72021°, -117.65224°), USGS Field Station, pitfall trap array LIM-2, 20 Jul 1999, 385m (Coll. USGS), 1 juvenile (AMNH); Limestone Canyon (33.72037°, -117.6563°), USGS Field Station, pitfall trap array LIM-6, 21 Aug 2001, 424m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.71621°, -117.65892°), USGS Field Station, pitfall trap array LIM-4, 23 Aug 2000, 456m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.72733°, -117.67281°), USGS Field Station, pitfall trap array LIM-0, 19 Jul 1997 (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.72124°, -117.64891°), USGS Field Station, pitfall trap array LIM-1, 23 Aug 2000, 354m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73373°, -117.67053°), USGS Field Station, pitfall trap array LIM-11, 21 Aug 2001, 338m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.71954°, -117.65611°), USGS Field Station, pitfall trap array LIM-3, 23 Aug 2000, 405m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73686°, -117.69222°), USGS Field Station, pitfall trap array LIM-8, 21 Aug 2001, 448m (Coll. USGS), 1 adult male (AMNH); Limestone Canyon (33.73894°, -117.67444°), pitfall trap array 13, 21-25 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Limestone Canyon (33.73655°, -117.69358°), pitfall trap array 16, 20-30 Sept 1999 (Coll. USGS), 1 adult male (DMNS); Rattlesnake Reservoir (33.7317°, -117.72954°), USGS Field Station, pitfall trap array RAT-2, 5 Sept 2000, 151m (Coll. USGS), 1 adult male (AMNH); Rattlesnake Reservoir (33.73464°, -117.736°), USGS Field Station, pitfall trap array RAT-5, 9 Jul 2001, 139m (Coll. USGS), 1 adult male (AMNH); Rattlesnake Reservoir (33.7317°, -117.72954°), USGS Field Station, pitfall trap array RAT-2, 17 Aug 1999, 151m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.55741°, -117.76174°), USGS Field Station, pitfall trap array AWC-17, 1 Feb 2000, 295m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.55741°, -117.76174°), USGS Field Station, pitfall trap array AWC-17, 7 Oct 2002, 295m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.55741°, -117.76174°), USGS Field Station, pitfall trap array AWC-17, 16 Sept 2002, 295m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.5699°, -117.75633°), USGS Field Station, pitfall trap array AWC-16, 12 Aug 2002, 215m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.5699°, -117.75633°), USGS Field Station, pitfall trap array AWC-16, 30 Jul 2001, 215m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.5699°, -117.75633°), USGS Field Station, pitfall trap array AWC-16, 27 Aug 2001, 215m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.57698°, -117.74787°), USGS Field Station, pitfall trap array AWC-13, 25 Jun 2001, 105m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.58384°, -117.7503°), USGS Field Station, pitfall trap array AWC-14, 22 May 2001, 206m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.57403°, -117.74935°), USGS Field Station, pitfall trap array AWC-12, 12 Aug 2002, 104m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood Canyon (33.55759°, -117.74647°), USGS Field Station, pitfall trap array AWC-9, 27 Aug 2001, 64m (Coll. USGS), 1 juvenile (AMNH); Aliso-Wood Canyon (33.57698°, -117.74787°), USGS Field Station, pitfall trap array AWC-13, 3 Oct 2000, 105m (Coll. USGS), 2 adult males (AMNH); Aliso-Wood Canyon (3.55692°, -117.7457°), USGS Field Station, pitfall trap array AWC-8, 27 Aug 2001, 64m (Coll. USGS), 1 adult male (AMNH); Aliso-Wood

Canyon (33.55759, -117.74647°), pitfall trap array 9, 3-13 Oct 2000 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.55759°, -117.74647°), pitfall trap array 9, 1-11 Feb 2000 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.51854°, -117.73869°), pitfall trap array 1, 22-26 May 2001 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.55759°, -117.74647°), pitfall trap array 9, 1-11 Jul 2000 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.55759°, -17.74647°), pitfall trap array 9, 30 Jul to 3 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.51854°, -117.73869°), pitfall trap array 1, 1-11 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.51854°, -117.73869°), pitfall trap array 1, 1-11 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Aliso-Wood Canyon (33.52641°, -117.73584°), pitfall trap array 2, 2-6 Oct 2001 (Coll. USGS), 1 adult male (DMNS); Chino Hills (33.91359°, -117.80915°), USGS Field Station, pitfall trap array CHI-15, 3 Aug 1998, 187m (Coll. USGS), 2 adult males (AMNH); Chino Hills (33.91163°, -117.78886°), USGS Field Station, pitfall trap array CHI-9, 3 Aug 1998, 355m (Coll. USGS), 2 adult males (AMNH); Chino Hills (33.91163°, -117.78886°), USGS Field Station, pitfall trap array CHI-9, 21 Mar 2001, 355m (Coll. USGS), 2 adult males (AMNH); Chino Hills (33.91359°, -11780915°), USGS Field Station, pitfall trap array CHI-15, 14 Aug 2001, 187m (Coll. USGS), 2 adult males (AMNH); Chino Hills (33.94229°, -117.81696°), USGS Field Station, pitfall trap array CHI-19, 16 Jul 2001, 411m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91039°, -117.80635°), USGS Field Station, pitfall trap array CHI-12, 14 Aug 2001, 283m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91359°, -117.80915°), USGS Field Station, pitfall trap array CHI-15, 16 Jul 2001, 187m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91337°, -117.81091°), USGS Field Station, pitfall trap array CHI-16, 17 Sept 2001, 179m (Coll. USGS), 1 adult female (AMNH); Chino Hills (33.91369°, -117.80915°), USGS Field Station, pitfall trap array CHI-15, 17 Sept 2001, 187m (Coll. USGS), 1 adult female (AMNH); Chino Hills (33.91163°, -117.78886°), USGS Field Station, pitfall trap array CHI-9, 5 Oct 1998, 355m (Coll. USGS), 1 subadult female (AMNH); Chino Hills (33.91196°, -117.7891°), USGS Field Station, pitfall trap array CHI-10, Jul 1999, 358m (Coll. USGS),  subadult female (AMNH); Chino Hills (33.91448°, -117.78555°), USGS Field Station, pitfall trap array CHI-32, 8 Jul 2002, 238m (Coll. USGS), 1 juvenile (AMNH); Chino Hills (33.94039°, -117.81659°), USGS Field Station, pitfall trap array CHI-18, 17 Sept 2001, 402m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91099°, -117.78917°), USGS Field Station, pitfall trap array CHI-8, 17 Sept 2001, 354m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91445°, -117.80782°), USGS Field Station, pitfall trap array CHI-14, 17 Sept 2001, 172m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91123°, -117.80184°), USGS Field Station, pitfall trap array CHI-11, 3 Jun 2002, 255m (Coll. USGS), 1 juvenile (AMNH); Chino Hills (33.90906°, -117.80655°), USGS Field Station, pitfall trap array CHI-13, 7 May 2001, 264m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.8837°, -117.67184°), USGS Field Station, pitfall trap array CHI-6, 14 Aug 2001, 150m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.8837°, -117.67184°), USGS Field Station, pitfall trap array CHI-6, 3 Aug 1998, 150m (Coll. USGS), 1 adult male (AMNH); Chino Hills (33.88486°, -117.67231°), USGS Field Station, pitfall trap array CHI-5, 7 May 2001, 126m

(Coll. USGS), 1 adult male (AMNH); Chino Hills (33.91448°, -117.78555°), pitfall trap array 32, 7-11 Apr 2003 (Coll. USGS), 1 adult male (DMNS); Chino Hills (33.92821°, -117.76606°), pitfall trap array 29, 2-6 Jun 2003 (Coll. USGS), 1 adult male (DMNS); Chino Hills (33.92821°, -117.76606°), pitfall trap array 29, 17-21 Sept 2001 (Coll. USGS), 1 adult male (DMNS); Chino Hills (33.93932°, -117.81698°), pitfall trap array 17, 2-12 Aug 2000 (Coll. USGS), 1 adult male (DMNS); Chino Hills (33.93932°, -117.81698°), pitfall trap array 17, 3-13 Aug 1998 (Coll. USGS), 1 adult male (DMNS); Weir Canyon (33.81605°, -117.4704°), USGS Field Station, pitfall trap array WIR-5, 17 Aug 1999, 213m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83518°, -117.7293°), USGS Field Station, pitfall trap array WIR-10, 10 Sept 2001, 275m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83518°, -117.7293°), USGS Field Station, pitfall trap array WIR-10, 25 Apr 2001, 275m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83518°, -117.7293°), USGS Field Station, pitfall trap array WIR-10, 15 Jun 1999, 275m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83518°, -117.7293°), USGS Field Station, pitfall trap array WIR-10, 17 Aug 1999, 275m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83518°, -117.7293°), USGS Field Station, pitfall trap array WIR-10, 12 Nov 2001, 275m (Coll. USGS), 1 of unknown age and sex (AMNH); Weir Canyon (33.83762°, -117.72196°), USGS Field Station, pitfall trap array WIR-12, 6 Aug 2001, 354m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83762°, -117.72196°), USGS Field Station, pitfall trap array WIR-12, Nov 1999, 354m (Coll. USGS), 1 juvenile (AMNH); Weir Canyon (33.83762°, -117.72196°), USGS Field Station, pitfall trap array WIR-12, 17 Aug 1999, 354m

(Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83824°, -117.2276°), USGS Field Station, pitfall trap array WIR-11, 6 Aug 2001, 373m (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.80994°, -117.75564°), USGS Field Station, pitfall trap array WIR-11, Mar 2002, 373m (Coll. USGS), 1 juvenile (AMNH); Weir Canyon (33.80994°, -117.75564°), USGS Field Station, pitfall trap array WIR-1, 11 Mar 2002, 236m (Coll. USGS), 1 adult female (AMNH); Weir Canyon (33.81555°, -117.74716°), USGS Field Station, pitfall trap array WIR-4, 6 Aug 2001 (Coll. USGS), 1 adult male (AMNH); Weir Canyon (33.83576°, -117.72983°), pitfall trap array 9, 17-27 Aug 1999 (Coll. USGS), 1 adult male (DMNS); Weir Canyon (33.81491°, -117.74678°), pitfall trap array 2, 5-15 Oct 1998 (Coll. USGS), 1 adult female (DMNS); Starr Ranch (33.60816°, -117.54692°), USGS Field Station, pitfall trap array STR-3, 13 Jul 1998, 427m (Coll. USGS), 1 adult female (AMNH); Starr Ranch (33.61137°, -117.54656°), USGS Field Station, pitfall trap array STR-4, 28 Nov 2000, 480m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.60921°, -117.55247°), USGS Field Station, pitfall trap array STR-10, 14 Sept 1998, 500m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.61543°, -117.54989°), USGS Field Station, pitfall trap array STR-7, Jun 1998, 513m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.61744°, -117.54379°), USGS Field Station, pitfall trap array STR-5, 14 Sept 1998, 457m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.61389°, -117.55047°), USGS Field Station, pitfall trap array STR-13, 14 Sept 1998, 484m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.6178°, -117.56276°), USGS Field Station, pitfall trap array STR-15, 14 Sept 1998, 252m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.61008°, -117.55115°), USGS Field Station, pitfall trap array

STR-9, 3 Apr 2000, 494m (Coll. USGS), 1 adult male (AMNH); Starr Ranch (33.60289°, -117.54427°), pitfall trap array 1, 14-24 Sept 1998 (Coll. USGS), 1 adult male (DMNS); 0.5 mi NE Laguna Beach city limits, along County Rt. S18, 21 Feb 1972 (R. Haradon, J. Marks), 1 adult female, 4 subadult male, 4 subadult female, 2 juveniles (CAS); San Joaquin Hills West (33.58989°, -117.82034°), pitfall trap array 21, 17-28 Oct 2000 (Coll. USGS), 1 adult male (DMNS); San Joaquin Hills West (33.58989°, -117.82034°), pitfall trap array 21, 14-24 Mar 2001 (Coll. USGS), 1 adult male (DMNS); San Joaquin Hills West (33.60457°, -117.80281°), pitfall trap array 9, 29 Apr to 3 May 2002 (Coll. USGS), 1 adult male (DMNS), San Joaquin Hills West (33.59068°, -117.76168°), pitfall trap array 1, 1-11 Aug 2001 (Coll. USGS), 1 adult male (DMNS); San Joaquin Hills West (33.55925°, -117.80777°), pitfall trap array A, 11-15 Jun 2001 (Coll. USGS), 1 adult unknown sex (DMNS); San Joaquin Hills West (33.55925°, -117.80777°), pitfall trap array 11, 30 Sept to 4 Oct 2002 (Coll. USGS), 1 adult male (DMNS); San Joaquin Hills West (33.59004°, -117.79312°), pitfall trap array 14, 7-11 Apr 2003 (Coll. USGS), 1 adult male (DMNS); San Joaquin Hills West (33.59004°, -117.79312°), pitfall trap array 14, 11-15 Jun 2001 (Coll. USGS), 1 adult male (DMNS); Agua Chinon (33.70587°, -117.67652°), pitfall trap array 1, 20-30 Mar 2000 (Coll. USGS), 1 adult male (DMNS); Edison Easement (33.66536°, -117.63848°), pitfall trap array 1, 1-11 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Edison Easement (33.66699°, -117.63897°), USGS Field Station, pitfall trap array EDI-2, 7 Aug 2001, 312m (Coll. USGS), 1 adult male (AMNH); Edison Easement (33.66796°, -117.63904°), USGS Field Station, pitfall trap array EDI-3, 3 Apr 2000, 304m (Coll. USGS), 1 adult male (AMNH); Edison Easement

(33.66699°, -117.63897°), USGS Field Station, pitfall trap array EDI-2, 10 Sept 2001 (Coll. USGS), 1 adult male (AMNH); ***Riverside County*****:** Hwy 79 South (Temecula-Indio) at intersection with Woodchuck Road (33.1687667°, -117.0079667°), Site 33, 20 Sept 2012, 497m (L. Prendini & W. E. Savary), 1 adult male (AMNH); Motte Rimrock Reserve (33.80733°, -117.25724°), USGS Field Station, pitfall trap array MOT-5, 26 Oct 1998, 571m (Coll. USGS), 1 adult male (AMNH); Motte Rimrock Reserve (33.80496°, -117.25403°), USGS Field Station, pitfall trap array MOT-3, 24 Aug 1998, 559m (Coll. USGS), 1 adult male (AMNH); Motte Rimrock Reserve (33.81364°, -117.25877°), USGS Field Station, pitfall trap array MOT-9, 24 Aug 1998, 577m (Coll. USGS), 1 adult male (AMNH); Motte Rimrock Reserve (33.80981°, -117.25637°), USGS Field Station, pitfall trap array MOT-6, 24 Aug 1998, 574m (Coll. USGS), 1 adult male (AMNH); Motte Rimrock Reserve (33.81153°, -117.25703°), USGS Field Station, pitfall trap array MOT-8, 24 Aug 1998, 588m (Coll. USGS), 1 adult male (AMNH); Motte Rimrock Reserve (33.80452°, -117.25188°), USGS Field Station, pitfall trap array MOT-2, 24 Aug 1998, 571m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.50529°, -117.32885°), USGS Field Station, pitfall trap array TEN-18, 5 Oct 1999, 692m (Coll. USGS), 1 adult female (AMNH); Tenaja Corridor 1 (33.50529°, -117.32885°), USGS Field Station, pitfall trap array TEN-18, 8 Aug 1999, 692m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.50259°, -117.33861°), USGS Field Station, pitfall trap array TEN-29, 8 Aug 1999, 685m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.50311°, -117.33704°), USGS Field Station, pitfall trap array TEN-25, 8 Aug 1999, 658m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.50286°, -117.34063°), USGS Field Station, pitfall trap array TEN-28, 8 Aug 1999, 690m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.50529°, -117.32885°), USGS Field Station, pitfall trap array TEN-18, 6 Sept 2000, 692m (Coll. USGS), 1 adult female (AMNH); Tenaja Corridor 1 (33.50268°, -117.34644°), USGS Field Station, pitfall trap array TEN-31, 8 Aug 1999, 646m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 1 (33.5012°, -117.32799°), USGS, pitfall trap array TEN-21, 8 Aug 1999, 685m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.5114°, -117.31352°), USGS Field Station, pitfall trap array TEN-14, 9 Jul 1999, 661m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.51419°, -117.29976°), USGS Field Station, pitfall trap array TEN-5, 9 Jul 1999, 607m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.5133°, -117.30082°), USGS Field Station, pitfall trap array TEN-6, 9 Jul 1999, 615m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.51097°, -117.36529°), USGS Field Station, pitfall trap array TEN-36, 19 Sept 2000, 611m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.511°, -117.31474°), USGS Field Station, pitfall trap array TEN-10, 21 Sept 1999 (Coll. USGS), 1 subadult female (AMNH); Tenaja Corridor 2 (33.51069°, -117.30117°), USGS Field Station, pitfall trap array TEN-7, 17 Jan 2000, 614m (Coll. USGS), 1 subadult male (AMNH); Tenaja Corridor 2 (33.50553°, -117.36409°), USGS Field Station, pitfall trap array TEN-40, 9 Jul 1999, 599m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.51252°, -117.30123°), USGS Field Station, pitfall trap array TEN-8, 9 Jul 1999, 605m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2 (33.5104°, -117.36875°), USGS Field Station, pitfall trap array TEN-38, 19 Sept 2000, 604m (Coll. USGS), 1 adult male (AMNH); Tenaja Corridor 2

(33.51266°, -117.36792°), USGS Field Station, pitfall trap array TEN-37, 19 Sept 2000, 607m (Coll. USGS), 1 adult male (AMNH); Rawson Canyon (33.63103°, -117.00866°), USGS Field Station, pitfall trap array RAW-7, 3 Aug 1998, 655m (Coll. USGS), 1 adult male (AMNH); Rawson Canyon (33.6313°, -117.00799°), USGS Field Station, pitfall trap array RAW-6, 1 May 2000, 647m (Coll. USGS), 1 adult male (AMNH); Rawson Canyon (33.63691°, -117.00219°), USGS Field Station, pitfall trap array RAW-2, 3 Aug 1998, 677m (Coll. USGS), 1 adult male (AMNH); Rawson Canyon (33.63153°, -117.00659°), USGS Field Station, pitfall trap array RAW-5, 31 Jul 2000, 649m (Coll. USGS), 2 adult males (AMNH); Lake Perris State Rec Area (33.86384°, -117.20338°), San Jacinto Wildlife Area, pitfall trap array 1, 24 Aug to 3 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Lake Perris State Rec. Area (33.86384°, -117.20338°), San Jacinto Wildlife, 24 Aug to 3 Sept 1998 (Coll. USGS), 1 juvenile (DMNS); Lake Perris State Rec. Area (33.86384°, -117.20338°), San Jacinto Wildlife, 21 Apr to 1 May 1998 (Coll. USGS), 1 adult male (DMNS); North Hills (33.70247°, -117.01648°), pitfall trap array 1, 14-24 Sept 1998 (Coll. USGS), 1 adult male (DMNS); North Hills (33.70247°, -117.01648°), pitfall trap array 1, 4-14 Jun 2000 (Coll. USGS), 1 adult male (DMNS); Lake Skinner (33.57954°, -117.06571°), pitfall trap array 1, 1-11 May 2000 (Coll. USGS), 1 adult male (DMNS); Lake Skinner (33.57954°, -117.06571°), pitfall trap array 1, 3-13 Aug 1998 (Coll. USGS), 1 adult male (DMNS); Lake Skinner (33.57954°, -117.06571°), pitfall trap array 1, 31 Jul to 10 Aug 2000 (Coll. USGS), 1 adult male (DMNS); Santa Margarita Ecological Reserve (33.44067°, -117.17406°), USGS Field Station, pitfall trap array SMR-10, 22 Aug 2000, 302m (Coll. USGS), 1 adult male

(AMNH); Santa Margarita Ecological Reserve (33.44067°, -117.17406°), USGS Field Station, pitfall trap array SMR-10, 7 Sept 1999, 302m (Coll. USGS), 1 adult male (AMNH); Santa Margarita Ecological Reserve (33.43883°, -117.1798°), USGS Field Station, pitfall trap array SMR-11, 22 Aug 2000, 256m (Coll. USGS), 1 adult male (AMNH); Santa Margarita Ecological Reserve (33.43883°, -117.1798°), USGS Field Station, pitfall trap array SMR-11, 7 Sept 1999, 356m (Coll. USGS), 1 adult male (AMNH); Santa Margarita Ecological Reserve (33.43883°, -117.1798°), USGS Field Station, pitfall trap array SMR-11, 22 Aug 2000, 256m (Coll. USGS), 1 adult male (AMNH); Santa Margarita Ecological Reserve (33.44067°, -117.17406°), USGS Field Station, pitfall trap array SMR-10, 7 Sept 1999, 302m (Coll. USGS), 1 adult male (AMNH); Santa Margarita Ecological Reserve (33.4402833°, -117.1604667°), USGS pitfall site, Site 16 and 21B, 17-18 Sept 2012, 431m (L. Prendini and W. E. Savary), 5 adult females, 1 subadult male, 3 subadult females, 2 juvenile males, 2 juvenile females (AMNH); Strawberry Creek, San Bernardino Nat'l. Forest, elev. 3000 ft., (under rock in chaparral), 24 Feb 1967 (V. Lee), 1 male (CAS); along State Rt. 74, approx. 12.7 mi W Hemet, 6.6 mi E jct. County Rt. R1, 21 Feb 1971 (R. Haradon, J. Marks), 1 female (CAS); ***San Benito County*:** Pinnacles Nat'l Monument off North Wilderness Trail (36.49726°, -121.21128°), 14 May to 14 Jun 2010, 447m (Cushing et al.), 1 adult male (DMNS); Pinnacles National Monument, 23 Mar 1968 (S. Williams), 1 sub female (CAS); Paicines, 12 July 1955 (no collector), 1 male (CAS); ***San Bernardino County*:** San Bernardino Nat'l Forest, Coxey Truck trail, N side (34.3239278°, -117.0569417°), 8 May 2008, 1816m (Z. Valois & B. E. Hendrixson), 1 subadult male, 1 subadult female, 3 juveniles (AMNH); Mount Laguna Radar Station, 22 May 1963 (C. Parrish), 1 adult female (CAS); Yucca Valley, along the W slope of Rt 52 at the S edge of town, 14 Feb 1971 (R. M. Haradon & J. Marks), 1 adult male (CAS); Forest Falls, 16 July 1970 (T. Lutz), 2 males (CAS); Forest Falls, no date (no collector), 1 male (CAS); Yucca Valley, along the W slope of Rt. 62 at the edge of town, 14 Feb 1971 (R. Haradon, J. Marks), 1 male (CAS); Hinkley, 16 Feb 1972 (G. Kamrath), 1 female (CAS); Hinkley, 28 Sept 1972 (no collector), 1 male (CAS); N side San Bernardino Mts., S side Lucerne Valley Station 15, 25 May 1960 (B. Banta, K. Norris), 1 male (CAS); San Bernardino Mts., E side of San Gorgonio Peak, elev. 5500 ft., 3 Jan 1970 (G. Franklin), 1 sub female (CAS); ***San Diego County*:** La Jolla, 1928 (no collector), 1 adult female (AMNH); Mission Trails (32.81654°, -117.04082°), USGS Field Station, pitfall trap array MIS-3, 10 Sept 2001, 213m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81487°, -117.0419°), USGS Field Station, pitfall trap array MIS-4 16 Apr 2001, 170m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81677°, -117.04182°), USGS Field Station, pitfall trap array MIS-2, 17 Apr 2000, 190m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81654°, -117.04082°), USGS Field Station, pitfall trap array MIS-3, 17 Apr 2000, 213m (Coll. USGS), 4 adult males (AMNH); Mission Trails (32.81677°, -117.04182°), USGS Field Station, pitfall trap array MIS-2, 17 Apr 2000, 190m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81654°, -117.04082°), USGS Field Station, pitfall trap array MIS-3, 10 Sept 2001, 213m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81487°, -117.0419°), USGS Field Station, pitfall trap array MIS-4, 14 Aug 2001, 170m (Coll. USGS), 2 adult males (AMNH); Mission Trails

(32.81654°, -117.04082°), USGS Field Station, pitfall trap array MIS-3, 17 Apr 2000, 213m (Coll. USGS), 4 adult males (AMNH); Mission Trails (32.81487°, -117.0419°), USGS Field Station, pitfall trap array MIS-4, 16 Apr 2001, 170m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81677°, -117.04182°), USGS Field Station, pitfall trap array MIS-2, 16 Apr 2001, 190m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81677°, -117.04182°), USGS Field Station, pitfall trap array MIS-2, 14 Aug 2001, 190m (Coll. USGS), 1 adult male (AMNH); Mission Trails (32.81677°, -117.04182°), USGS Field Station, pitfall trap array MIS-2, 1 Oct 2001, 190m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.84088°, -116.87195°), USGS Field Station, pitfall trap array CRE-3, 14 Aug 2001, 260m (Coll. USGS), 5 adult males, 1 juvenile (AMNH); La Cresta (32.841°, -116.87075°), USGS Field Station, pitfall trap array CRE-4, Feb 1999 to Oct 1999, 295m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.84088°, -116.87195°), USGS Field Station, pitfall trap array CRE-3, 10 Sept 2001, 260m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.841°, -116.87075°), USGS Field Station, pitfall trap array CRE-4, 1 Oct 2001, 295m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.841°, -116.87075°), USGS Field Station, pitfall trap array CRE-4, 9 Jul 2001, 295m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.84088°, -116.87195°), USGS Field Station, pitfall trap array CRE-3, 19 Sept 2000, 260m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.84088°, -116.87195°), USGS Field Station, pitfall trap array CRE-3, 19 Sept 2000, 260m (Coll. USGS), 1 adult male (AMNH); La Cresta (32.841°, -116.87075°), USGS Field Station, pitfall trap array CRE-4, 14 Aug 2001, 295m (Coll. USGS), 3 adult males (AMNH); La Cresta (32.83471°, -116.8629°), pitfall trap array 5, 19-29 Sept 2000 (Coll. USGS), 1 adult male (DMNS); La Cresta (32.84237°, -116.87255°), pitfall trap array 1, 13 Oct 1999 to 23 Mar 2002 (Coll. USGS), 1 adult male (DMNS); La Cresta (32.84237°, -116.87225°), pitfall trap array 1, 10-14 Sept 2001 (Coll. USGS), 1 adult male (DMNS); La Cresta (32.84237°, -116.87255°), pitfall trap array 1, 13 Oct 1999 to 23 Mar 2002 (Coll. USGS), 1 adult male (DMNS); San Felipe Valley, N side of SR78, just W of W entrance into Anza Borrego State Park (33.1005361°, -116.45955°), 1 Aug 2008, 684m (Z. J. Valois & W. E. Savary), 1 subadult male (AMNH); San Felipe Valley, N side of SR78, just W of W entrance into Anza Borrego State Park (33.1005361°, -116.45955°), 1 Aug 2008, 684m (Z. J. Valois & W. E. Savary), 1 adult male (AMNH); Banner Canyon, S along SR78 (33.0712722°, -116.5425306°), 1 Aug 2008, 811m (Z. J, Valois & W. E. Savary), 1 juvenile female (AMNH); Marron Valley (32.59511°, -116.76537°), USGS Field Station, pitfall trap array MAR-3, 13 Oct 1998, 390m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59379°, -116.76332°), USGS Field Station, pitfall trap array MAR-4, 24 May 1999, 332m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59558°, -116.76608°), USGS Field Station, pitfall trap array MAR-2, 13 Oct 1999, 390m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.62616°, -116.7758°), USGS Field Station, pitfall trap array MAR-7, 14 Aug 2000, 490m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59379°, -116.76332°), USGS Field Station, pitfall trap array MAR-4, 14 Aug 2000, 332m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59558°, -116.76608°), USGS Field Station, pitfall trap array MAR-2, 9 Feb 1999, 390m (Coll. USGS), 2 adult males (AMNH); Marron Valley (33.62715°, -116.77699°), USGS Field Station, pitfall trap array MAR-8, 13 Oct 1998, 482m (Coll. USGS), 2 adult males (AMNH); Marron Valley (32.59379°, -116.76332°), USGS Field Station, pitfall trap array MAR-4, 1 Jun 1998, 332m (Coll. USGS), 1 juvenile (AMNH); Marron Valley (32.59379°, -116.76332°), USGS Field Station, pitfall trap array MAR-4, 18 Jan 2000, 332m (Coll. USGS), 1 juvenile (AMNH); Marron Valley (32.59245°, -116.76284°), USGS Field Station, pitfall trap array MAR-5, 14 Aug 2000, 324m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59245°, -116.76284°), USGS Field Station, pitfall trap array MAR-5, 1 Jun 1998, 324m (Coll. USGS), 1 adult male (AMNH); Marron Valley (32.59245°, -116.76284°), USGS Field Station, pitfall trap array MAR-5, 9 Feb 1999, 324m (Coll. USGS), 1 adult unknown sex (AMNH); Marron Valley (32.59459°, -116.76679°), pitfall trap array 1, 9-19 Feb 1999 (Coll. USGS), 1 adult male (DMNS);Wild Animal Park (33.10042°, -116.97224), USGS Field Station, pitfall trap array WAP-18, 22 Jun 1998 (Coll. USGS), 1 adult female (AMNH); Wild Animal Park (33.09965°, -116.9736°), USGS Field Station, pitfall trap array WAP-17, 26 Oct 1998, 255m (Coll. USGS), 1 subadult female (AMNH); Wild Animal Park (33.09794°, -116.97982°), USGS Field Station, pitfall trap array WAP-16, 22 Jun 1998, 254m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.09769°, -116.97824°), USGS Field Station, pitfall trap array WAP-15, 15 May 2000, 254m (Coll. USGS), 2 adult males (AMNH); Wild Animal Park (33.09769°, -116.97824°), USGS Field Station, pitfall trap array WAP-15, 24 Aug 1998, 254m (Coll. USGS), 3 adult males (AMNH); Wild Animal Park (33.08931°, -116.98887°), USGS Field Station, pitfall trap array WAP-6, 2 Aug 2000, 177m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park

(33.09164°, -116.9818°), USGS Field Station, pitfall trap array WAP-2, 15 May 2000, 146m (Coll. USGS), 2 adult males (AMNH); Wild Animal Park (33.09321°, -116.98497°), USGS Field Station, pitfall trap array WAP-8, Dec 2000, 191m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.09516°, -116.98321°), USGS Field Station, pitfall trap array WAP-10, 19 Apr 1998, 247m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.09965°, -116.9736°), USGS Field Station, pitfall trap array WAP-17, 19 Apr 1998, 255m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.09121°, -116.98299°), USGS Field Station, pitfall trap array WAP-4, 15 May 2000, 173m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.09641°, -116.97877°), USGS Field Station, pitfall trap array WAP-13, 18 Apr 1998, 254m (Coll. USGS), 1 adult male (AMNH); Wild Animal Park (33.10183°, -116.97263°), pitfall trap array 20, 18-22 Apr 2011 (Coll. USGS), 2 adult males (DMNS); Wild Animal Park (33.09965°, -116.9736°), pitfall trap array 17, 18-22 Apr 2011 (Coll. USGS), 1 adult male (DMNS); Wild Animal Park (33.08983°, -116.98668°), pitfall trap array 5, 6-10 Sept 2010 (Coll. USGS), 3 adult males (DMNS); Wild Animal Park (33.09761°, -116.98011°), pitfall trap array 14, 18-22 May 2009 (Coll. USGS), 2 adult males, 1 juvenile (DMNS); Torrey Pines 2 (32.9433°, -117.2525°), USGS Field Station, pitfall trap array TP2-8, Nov 1999, 90m (Coll. USGS), 1 subadult female (AMNH); Torrey Pines 2 (32.94234°, -117.24825°), USGS Field Station, pitfall trap array TP2-9, 14 Sept 1998, 120m (Coll. USGS), 1 subadult male (AMNH); Torrey Pines 2 (32.93975°, -117.25092°), USGS Field Station, pitfall trap array TP2-3, Apr 2000, 69m (Coll. USGS), 1 adult female (AMNH); Torrey Pines 2 (32.93981°, -117.25184°), USGS Field

Station, pitfall trap array TP2-2, Jul 1999, 62m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 2 (32.93975°, -117.25092°), USGS Field Station, pitfall trap array TP2-3, 13 Jul 1998, 69m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 2 (32.94082°, -117.24776°), USGS Field Station, pitfall trap array TP2-10, 14 Sept 1998, 122m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 2 (32.93975°, -117.25092°), USGS Field Station, pitfall trap array TP2-3, 11 May 1998, 69m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 2 (32.9433°, -117.2525°), USGS Field Station, pitfall trap array TP2-8, Sept 1996, 90m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 2 (32.94105°, -117.2529°), USGS Field Station, pitfall trap array TP2-6, 14 Sept 1998, 73m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 1 (32.91388°, -117.25023°), USGS Field Station, pitfall trap array TP1-7, 22 Jun 1998, 101m (Coll. USGS), 1 adult male (AMNH); Spring Canyon (32.56156°, -116.99828°), USGS Field Station, pitfall trap array SPR-7, 6 Sept 2000, 130m (Coll. USGS), 1 adult male (AMNH); Spring Canyon (32.56011°, -117. 00057°), USGS Field Station, pitfall trap array SPR-6, Sept 1999, 107m (Coll. USGS), 2 adult males (AMNH); Spring Canyon (32.55458°, -116.99883°), USGS Field Station, pitfall trap array SPR-3, 23 Sept 2002, 138m (Coll. USGS), 2 adult males (AMNH); Spring Canyon (32.55039°, -116.9969°), pitfall trap array 1, 25 Feb to 1 Mar 2002 (Coll. USGS), 1 adult male (DMNS); Spring Canyon (32.55039°, -116.9969°), pitfall trap array 1, 6-16 Sept 2000 (Coll. USGS), 1 adult male (DMNS); Chula Vista II (32.65064°, -116.99339°), USGS Field Station, pitfall trap array CV2-8, Feb 2000, 90m (Coll. USGS), 1 unknown age and sex (AMNH); Chula Vista II (32.65064°, -116.99339°), USGS Field Station, pitfall trap array CV2-8, 14 Nov 1998, 90m

(Coll. USGS), 1 adult male (AMNH);  Chula Vista II (32.65291°, -116.99721°), USGS Field Station, pitfall trap array CV2-9, 14 Sept 1998, 87m (Coll. USGS), 1 adult female (AMNH); Chula Vista II (32.65017°, -116.99211°), USGS Field Station, pitfall trap array CV2-7, 7 Sept 1999, 90m (Coll. USGS), 1 adult male (AMNH); Chula Vista II (32.65017°, -116.99211°), USGS Field Station, pitfall trap array CV2-7, 14 Sept 1998, 90m (Coll. USGS), 1 adult male, 1 subadult female (AMNH); Chula Vista II (32.66305°, -116.98059°), USGS Field Station, pitfall trap array CV2-4, 16 Feb 2000, 152m (Coll. USGS), 1 adult male, 1 adult of unknown sex (AMNH); Chula Vista II (32.66305°, -116.98059°), USGS Field Station, pitfall trap array CV2-4, 15 Nov 1998, 152m (Coll. USGS), 1 adult male; Chula Vista II (32.66227°, -116.97972°), USGS Field Station, pitfall trap array CV2-3, 25 Apr 2000, 157m (Coll. USGS), 1 adult male (AMNH); Chula Vista II (33.66247°, -116.9797°), USGS Field Station, pitfall trap array CV2-2, 14 Sept 1998, 158m (Coll. USGS), 1 adult male (AMNH); Chula Vista II (32.65005°, -116.99087°), pitfall trap array 6, 14-24 Apr 1999 (Coll. USGS), 1 adult male (DMNS); Chula Vista II (32.65005°, -116.99087°), pitfall trap array 6, 14-24 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Torrey Pines 3 (32.92703°, -117.25629°), USGS Field Station, pitfall trap array TP3-13, 22 Jun 1998, 20m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92529°, -117.25179°), USGS Field Station, pitfall trap array TP3-11, 24 Aug 1998, 16m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92057°, -117.25746°), USGS Field Station, pitfall trap array TP3-4, 24 Aug 1998, 62m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92105°, -117.25743°), USGS Field Station, pitfall trap array TP3-6, 20 Apr 1998, 54m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92172°, -117.25684°), USGS Field Station, pitfall trap array TP3-7, May 1997, 59m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92094°, -117.25814°), USGS Field Station, pitfall trap array TP3-5, 24 Aug 1998, 44m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92383°, -117.25608°), USGS Field Station, pitfall trap array TP3-8, 22 Jun 1998, 70m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92522°, -117.25254°), USGS Field Station, pitfall trap array TP3-14, Jul 2000, 23m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92172°, -117.25684°), USGS Field Station, pitfall trap array TP3-7, 24 Aug 1998, 59m (Coll. USGS), 1 adult male (AMNH); Torrey Pines 3 (32.92055°, -117.25661°), pitfall trap array 1, 24 Aug to 3 Sept 1998 (Coll. USGS), 1 adult male (DMNS); San Diego Nat'l Wildlife Park (32.7204°, -116.95135°), USGS Field Station, pitfall trap array SWT-9, 28 Sept 1999, 112m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Park (32.72446°, -116.94318°), USGS Field Station, pitfall trap array SWT-3, 14 Sept 1998, 113m (Coll. USGS), 2 adult males (AMNH); San Diego Nat'l Wildlife Park (32.72517°, -116.94785°), USGS Field Station, pitfall trap array SWT-5, 20 Jun 2000, 105m (Coll. USGS), 1 subadult female (AMNH); San Diego Nat'l Wildlife Park (32.7204°, -116.95135°), USGS Field Station, pitfall trap array SWT-9, 3 May 1999, 112m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Park (32.72367°, -116.94833°), USGS Field Station, pitfall trap array SWT-6, 14 Sept 1998, 103m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Park (32.72272°, -116.94937°), USGS Field Station, pitfall trap array SWT-7, 20 Jul 1999, 108m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Park (32.7204°, -116.95135°), USGS Field

Station, pitfall trap array SWT-9, 18 Apr 2000, 112m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Refuge (32.7192°, -116.95218°), USGS Field Station, pitfall trap array SWT-10, 28 Sept 1999, 104m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Refuge (32.72529°, -116.9416°), USGS Field Station, pitfall trap array SWT- 2, 13 Jul 1998, 129m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Refuge (32.72411°, -116.94431°), USGS Field Station, pitfall trap array SWT-4, 14 Sept 1998, 101m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Refuge (32.72175°, -116.95009°), USGS Field Station, pitfall trap array SWT-8, 19 Sept 2000, 112m (Coll. USGS), 1 adult male (AMNH); San Diego Nat'l Wildlife Refuge (33.72436°, -116.89792°), 21-25 Apr 2008 (Coll. USGS), 1 adult male (DMNS); Tijuana Estuary (32.53841°, -117.10764°), USGS Field Station, pitfall trap array TJE-10, 6 Sept 2000, 53m (Coll. USGS), 1 adult male (AMNH); Tijuana Estuary (32.5841°, -117.10764°), USGS Field Station, pitfall trap array TJE-10, 27 Aug 2001, 53m (Coll. USGS), 1 adult male (AMNH); Tijuana Estuary (32.53782°, -117.10739°), USGS Field Station, pitfall trap array TJE-11, 5 Oct 1998, 63m (Coll. USGS), 1 adult male, 1 juvenile (AMNH); Tijuana Estuary (32.53782°, -117.10739°), USGS Field Station, pitfall trap array TJE-11, 27 Aug 2001, 63m (Coll. USGS), 3 adult males (AMNH); Santa Ysabel Ecological Reserve (33.10836°, -116.61601°), pitfall trap A, 7-11 Jul 2003 (Coll. USGS), 1 adult male (DMNS); Santa Ysabel Ecological Reserve (33.12334°, -116.62522°), pitfall trap array A, 10-14 Jul 2006 (Coll. USGS), 1 adult male (DMNS); Santa Ysabel Ecological Reserve (33.12461°, -116.67061°), pitfall trap A, 12-16 Jul 2009 (Coll. USGS), 1 adult female (DMNS); Santa

Ysabel Ecological Reserve (33.1347°, -116.65308°), pitfall trap array A, 15-19 Aug 2005 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.34365°, -117.36382°), pitfall trap array 17, 1-5 Oct 2001 (Coll. USGS), 1 adult of unknown sex (DMNS); Camp Pendleton (33.31787°, -117.46857°), pitfall trap array 7, 28 Sept to 9 Oct 1998 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.34512°, -117.50846°), pitfall trap array 2, 7-19 Mar 2000 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.41564°, -117.31867°), pitfall trap array 27, 23 Aug to 2 Sept 2000 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.31787°, -117.46857°), pitfall trap array 17, 5-9 Apr 2004 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.34512°, -117.50846°), pitfall trap array 2, 7-11 Jun 2004 (Coll USGS), 1 adult male (DMNS); Camp Pendleton (33.3742°, -117.43678°), pitfall trap array 10, 1-5 Oct 2001 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.3449°, -117.50874°), pitfall trap array 1, 7-11 Jun 2004 (Coll. USGS), 1 adult female (DMNS); Camp Pendleton (33.34365°, -117.36382°), pitfall trap array 17, 27-31 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.39044°, -117.56277°), pitfall trap array 12, 24-28 Jul 2006 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.37447°, -117.43694°), pitfall trap array 9, 27-31 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Camp Pendleton (33.3742°, -117.43678°), pitfall trap array 10, 15-24 Sept 1999 (Coll. USGS), 1 adult male (DMNS); Palomar (33.33489°, -116.94531°), pitfall trap array 12, 27-31 Oct 2008 (Coll. USGS), 1 adult male (DMNS); Palomar (33.33489°, -116.94531°), pitfall trap array 12, 16-20 Jun 2008 (Coll. USGS), 1 adult male (DMNS); Palomar (33.33464°, -116.9468°), 19-23 May 2008 (Coll. USGS), 1 adult male (DMNS); Palomar

(33.33489°, -116.94531°), pitfall trap array 12, 18-22 May 2009 (Coll. USGS), 2 adult males (DMNS); Rancho Jamul (32.67878°, -116.85516°), pitfall trap array 0, 30 Mar to 3 Apr 2009 (Coll. USGS), 2 adult males (DMNS); Rancho Jamul (32.6647°, -116.86695°), pitfall trap array 22, 20-24 Aug 2007 (Coll. USGS), 1 adult male (DMNS); Sunshine Summit, 2.6 mi SE on Hwy 79 to Warner Springs (33.3191167°, -116.6981167°), Site 15, 16 Sept 2012, 930m (L. Prendini & W. E. Savary), 1 adult male, 8 adult females (AMNH); Little Cedar Ridge (32.6159°, -116.86029°), pitfall trap array 1, 24-28 March 2008 (Coll. USGS), 1 adult male (AMNH); Elliot Reserve (32.8909°, -117.09747°), pitfall trap array 9, 23 Aug 2013 (Col. USGS), 2 adult males (DMNS); Elliot Reserve (32.89268°, -117.08907°), pitfall trap array 14, 8-12 Sept 2008 (Coll. USGS), 2 adult males (DMNS); Elliot Reserve (32.89175°, -117.09714°), pitfall trap array 8, 14-24 Sept 1998 (Coll. USGS), 1 adult male (DMNS); Elliot Reserve (32.89063°, -117.1026°), pitfall trap array 6, 20-30 Sept 2000 (Coll. USGS), 1 adult male (DMNS); Del Mar Mesa (32.94463°, -117.16807°), USGS Field Station, pitfall trap array DMM-2, 17 Jul 2001, 127m (Coll. USGS), 1 adult male (AMNH); Del Mar Mesa (32.94047°, -117.17421°), USGS Field Station, pitfall trap array DMM-5, 17 Jul 2001, 105m (Coll. USGS), 1 subadult female (AMNH); Del Mar Mesa (32.94462°, -117.16807°), USGS Field Station, pitfall trap array DMM-2, 29 Oct 2001, 127m (Coll. USGS), 1 adult male (AMNH); Del Mar Mesa (32.94017°, -117.17421°), USGS Field Station, pitfall trap array DMM-5, 6 Aug 2001, 105m (Coll. USGS), 2 adult males (AMNH); Del Mar Mesa (32.94038°, -117.17172°), USGS Field Station, pitfall trap array DMM-4, 6 Aug 2001, 126m (Coll. USGS), 1 adult male (AMNH); Del Mar Mesa (32.94038°, -117.17172°), USGS Field

Station, pitfall trap array DMM-4, 4 Sept 2001, 126m (Coll. USGS), 1 adult male (AMNH); Del Mar Mesa (32.94462°, -117.16807°), USGS Field Station, pitfall trap array DMM-2, 29 Oct 2001, 127m (Coll. USGS), 1 adult male (AMNH); Los Peñasquitos Reserve, Del Mar Mesa (32.9347167°, -117.1766667°), Site 29A, 19 Sept 2012, 65m (L. Prendini & W. E. Savary), 1 adult male, 1 adult female (AMNH); Del Mar Mesa (32.94233°, -117.16801°), USGS Field Station, pitfall trap array DMM-3, 17 Jul 2001, 102m (Coll. USGS), 3 adult males, 1 juvenile (AMNH); Del Mar Mesa (32.94233°, -117.16801°), USGS Field Station, pitfall trap array DMM-3, 9 Sept 2002, 102m (Coll. USGS), 1 adult male (AMNH); Del Mar Mesa (32.94208°, -117.17496°), USGS Field Station, pitfall trap array DMM-1, 8 Sept 2002, 104m (Coll. USGS), 1 adult male (AMNH); Los Peñasquitos Reserve, Del Mar Mesa (32.9393°, -117.1813333°), Site 28, 19 Sept 2012, 114m (L. Prendini & W. E. Savary), 3 adult males, 9 adult females, 3 subadult females, 2 juvenile males (AMNH); Del Mar Mesa (32.94227°, -117.1743°), pitfall trap array 1, 5-9 Aug 2002 (Coll. USGS), 1 adult male (DMNS); SDG&E Access Road (39.9526861°, -117.1689111°), 10 Jun 2012, 119m (P. Horsley & J. El Adli), 1 juvenile male, 1 juvenile female (AMNH); Lake Calavera Open Space Preserve, SDG&E Utility Road Trail (33.17245°, -117.2748333°), Site 23, 18 Sept 2012, 95m (L. Prendini & W. E. Savary), 3 adult females, 3 subadult females (AMNH); Los Peñasquitos Reserve, Carmel Mountain, intersection of Canter Heights and Arabian Crest streets (32.9268667°, -117.2138667°), Site 31, 19 Sept 2012, 109m (L. Prendini & W. E. Savary), 4 adult females, 2 subadult females, 8 juveniles (AMNH); Carmel Mountain (32.93118°, -117.21509°), USGS Field Station, pitfall trap array CAR-2, 9 Sept 2002, 127m (Coll. USGS), 1 adult male (AMNH); Carmel Mountain (32.93118°, -117.21364°), USGS Field Station, pitfall trap array CAR-3, 1 Oct 2001, 111m (Coll. USGS), 1 adult male (AMNH); Carmel Mountain (32.93118°, -117.21364°), USGS Field Station, pitfall trap array CAR-3, 6 Aug 2001, 111m (Coll. USGS), 2 adult males (AMNH); Carmel Mountain (32.9283°, -117.22278°), pitfall trap array 1, 6-10 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Carmel Mountain (32.9283°, -117.22278°), pitfall trap array 17, 6-10 Aug 2001 (Coll. USGS), 1 adult male (DMNS); Torrey Pines 2 (32.94105°, -117.2529°), USGS Field Station, pitfall trap array TP2-6, 13 Jul 1998, 73m (Coll. USGS), 1 adult male (AMNH); Wildcat Canyon, NNE El Cajon, Wildcat Canyon Road (32.9011389°, -116.8960556°), 20-21 Aug 2004, 440m (R. Mercurio, W. Savary, M. McCoy, & K. Bamba), 2 adult males, 1 adult female, 2 juveniles (AMNH); Dawson-Los Manos Canyon Reserve, Trail to Mt. Marron (33.1488°, -117.2488167°), Site 32, 19-20 Sept 2012, 99m (L. Prendini & W. E. Savary), 4 adult females, 7 juveniles (AMNH); 1 mi. N of Santee, 18 Sept 1970 (M. E. Soleglad), 1 holotype male (CAS); Alvarado Canyon, 6 Apr 1957 (S. Williams), 1 male (CAS); 4 mi N Black Canyon, in Mesa Grande (C. Parrish, R. Ashley), 1 male, 4 females, 1 juv (CAS); S slope of North Peak, Cuyamaca Mts., 24 Aug 1964 (C. Parrish), 1 female, 17 1st instars (CAS); S slope of North Peak, Cuyamaca Mts., 24 Aug 1964 (C. Parrish), 6 males (CAS); De Luz, 15 Aug 1962 (D. Pettus, R. Robin), 1 male (CAS); Fallbrook (label reads "Wallbrook"), 19 Jan 1951 (no collector), 1 male (CAS); La Jolla, 21 Apr 1964 (J. Smith), 1 male (CAS); Mt. Laguna Radar Station, 22 May 1963 (C. Parrish), 1 female (CAS); Mission Gorge, 1 mi W Padre Dam, elev. 100 ft., 7 July 1969 (S. Williams, V. Lee), 1 male, 2 females, 3 juvs

(CAS); San Diego, Apr 1957 (S. Williams), 1 male (CAS); Scissors Crossing, 5 Sept 1963 (C. Parrish), 1 male (CAS); 1 mi E San Ysidro, along Otay Mesa Rd., 6 Mar 1971 (R. Haradon, J. Marks), 1 male (CAS); N of U.S. Naval Air Station, Miramar, at jct. Miramar Rd. and Carroll Rd., 3 mi W Interstate Rt. 805 underpass, 27 Feb 1971 (R Haradon), 1 male, 2 females, 1 juv (CAS); Wildcat Canyon, near Lakeside, May 1962 (S. Williams), 1 male (CAS); ***San Luis Obispo County*****:** ca. 2 mi E San Luis Obispo, 26 Dec 1966 (K. Hom), 1 male (CAS); ca. 2 mi E San Luis Obispo, 26 Dec 1966 (M. Wong), 1 female (CAS); 1.3 mi W Hwy 101 on West Cuesta Rd., elev. 2400 ft., "7/4/70" (J.Hjelle, B. Proeres, F. Koehler), 1 female (CAS); ***Santa Barbara County*****:** Buellton, 22 June 1947 (no collector), 1 male (CAS); 6 mi N Lompoc (in burrow), 15 Feb 1962 (W. Simonds), 1 female (CAS); San Rafael Mts., vicinity of Figueroa Mt., Los Padres Nat'l. Forest, approx. 10 mi N jct. Happy Canyon Rd and Armour Ranch Rd, 13 Feb 1971 (R. Haradon, J. Marks), 1 male, 2 females, 5 juvs. (CAS); ***Tulare County*****:** 7.8 mi N Kernville (Kern Co.), Rt. 190, 12 June 1971 (R. Haradon, J. Marks), 1 male, 2 subadult females, 1 juv. (CAS); ***Ventura County*****:** Yerba Buena Rd N between Yellow Hill and Serranno Rd, Vicinity of Pacific Hwy 1 just over LA county line, no data (Chris Powell), 1 adult female (WDS); Yerba Buena Rd N between Yellow Hill and Serranno Rd, Vicinity of Pacific Hwy 1 just over LA county line, 8 Nov 1991 (Chris Powell), 1 adult female, 1 juvenile (WDS); 6 mi N Santa Paula, 29 Dec 1963 (E. Raina), 1 male (CAS); 4 mi N Santa Paula, elev. 500 ft., 8 Dec 1963 (D. Cooper), 1 female, 3 $1^{st}$ instars (CAS); 3 mi NW Santa Paula, 18 Dec 1963 (K. Jackson), 1 female (CAS); Casitas Spring, 1956 (Ventura Health Dept.), 1 male (CAS); Santa Monica Mts., along Yerba Buena Rd., 6.4

mi above jct. Coast Hwy (Rt. 1), 14 May 1972 (R. Haradon, J. Marks), 1male (CAS); along Yerba Buena (?) or Deer Creek Rd., 1.2 mi W jct. Yerba Buena and Little Sycamore Canyon Rd., 18 Aug 1971 (R. Haradon), 1 male (CAS); Santa Monica Mts., vicinity of Little Sycamore Canyon, 7.2 mi above jct. Rt. 1 and Yerba Buena Rd., 27 Dec 1970 (R. Haradon), 1 male, 2 females (CAS).

**Possible Spurious Records. USA: California: *Calaveras County*:** 3.8 mi SW Mokelumne Hill, Hwy 26, elev. 475m, 30 Sept 1988 (S. Williams), 1 adult female, 1 subadult female (CAS); 3.9 mi SW Mokelumne Hill, Hwy 26, elev. 450m, 30 Sept 1988 (S. Williams), 1 adult male, 1 adult female (CAS); 4.2 mi SW Mokelumne Hill, Hwy 26, elev. 400m, 30 Sept 1988 (S. Williams), 2 adult females (CAS); ***Contra Costa County*:** Richmond, Aug. 1952 (no collector), 1 male (CAS).

*Discussion of spurious records*. The series from Contra Costa County has been discussed previously by Soleglad and Fet where it was agreed per personal communication with Vincent Lee (CAS) that Richmond does not have appropriate habitat typical of *Anuroctonus* (Soleglad and Fet 2004). The series from Calaveras County are odd in that it is far disjunct from the nearest series locality sans Richmond in Contra Costa. For the purposes of this study, the series from Calaveras will be considered spurious.

**Unassignable Records. USA: California: *Los Angeles County*:** San Gabriel Mts, Along road to Crystal Lake, 1.0 mi NE of Jct St. Rt. 39, 25 Jun 1973 (R. M. Haradon & J. L. Marks), 7 adult males (CAS); San Gabriel Mts., along Big Tijunga Canyon Rd., 0.8 mi W jct. Angeles Forest Hwy, 30 May 1972 (R. Haradon, J. Marks), 1 male (CAS); San

Gabriel Mts., along State Rd. 39, 1.7 mi S road to Crystal Lake, 26 June 1973 (R. Haradon, J. Marks), 2 females (CAS); San Gabriel Mts., along road to Crystal Lake, 0.2 mi NE jct. State Rt. 39, 25 June 1973 (R. Haradon, J. Marks), 1 male (CAS); San Gabriel Mts., along road N4, 10.9 mi above jct. Rt. 138 at Pearblossum, 10 July 1972 (R. Haradon, J. Marks), 3 males (CAS); ***Riverside County*****:** Pine Cove, vicinity of Turner Lake/Trout Farm, 19 June 1971 (R. Haradon, J. Marks), 2 females (CAS); San Jacinto Mts, Pinyon Pines, 1.3 mi. N of Rt 74, 8 Jul 1972 (R. M. Haradon & J. L. Marks), 1 adult male, 2 juveniles (CAS); Pine Cove, vicinity of Turner Lake/Trout Farm, 19 Jul 1971 (R. Haradon & J. Marks), 2 adult females (CAS); Pinyon Flat, 1.3 mi. W of State Rt 74, Vicinity of Jct Palm Canyon Road and Bellavista, 14 Aug 1971 (R. Haradon & J. Marks), 3 adult males, 1 subadult female, 1 juvenile (CAS); Pinyon Flat Camp Ground, San Jacinto Mountains, 6 Jun 1970 (Cazier, Welch, & Francke), 2 adult males, 3 adult females, 6 juveniles (AMNH); San Bernardino Nat'l Forest, Pine Cove, 0.5 mi. S of Marion Ridge Drive, Intersection State Hwy 243 (33.7551333°, -116.7352167°), Site 25, 18 Sept 2012, 1847m (L. Prendini & W. E. Savary), 1 adult female, 8 juveniles (AMNH); San Bernardino Nat'l Forest, Pine Cove, Intersection of Marion Ridge Drive and State Hwy 243 (33.7610167°, -116.7378833°), Site 24, 19 Sept 2012, 1894m (L. Prendini & W. E. Savary), 1 adult female (AMNH); along County Rt. R1, approx. 1 mi N Pine Cove, 19 June 1971 (R. Haradon, J. Marks), 1 male, 2 females (CAS); San Jacinto Mts., Pinyon Pines, 1.3 mi N Rt. 74, 8 July 1972 (R. Haradon, J. Marks), 2 juvs. (CAS); ***San Bernardino County*****:** San Gabriel Mts., along Rt 2, 0.7 mi. E of Wrightwood, 7 Jul 1972 (R. M. Haradon & J. L. Marks), 5 adult males, 1 juvenile (CAS); approx. 1 mi below

Wrightwood off Rt. 28 June 1970 (R. Haradon), 1 male, 2 females, 1 sub female (CAS); 3.5 mi from jct. Rt. 138 and Rt. 2, on way to Wrightwood off Rt. 2, 28 June 1970 (R. Haradon), 2 males, 1 female, 1 juv (CAS).

# CHAPTER IV

## LITERATURE CITED

Anderson, R. C. 1975. Scorpions of Idaho. Tebiwa, 18(1):1-17.

Atchley, W. R., C. T. Gaskins, and D. Anderson. 1976. Statistical properties of ratios. I. Empirical results. Systematic Biology, 25(2):137-148.

Austin, H. M., D. Scoles, and A. J. Abell. 1999. Morphometric separation of annual cohorts within mid-Atlantic bluefish, *Pomatomus saltatrix*, using discriminant function analysis. Fishery Bulletin, 97(3):411-420.

Axelrod, D. I. 1973. History of the Mediterranean ecosystem in California. Ecological Studies, 7:225-277.

Banks, N. 1900a. Synopses of North American invertebrates. IX. The scorpions, solpugids and pedipalpi. American Naturalist, 34:421-427.

Banks, N. 1910. The scorpions of California. Pomona College Journal of Entomology, 2(2):185-190.

Bücherl, W. 1971. Classification, Biology, and Venom Extraction of Scorpions, pp. 317-347. *In*: Venomous Animals and Their Venoms. W. Bücherl and E. E. Buckley (eds.). Academic Press, New York. Vol. 3. 537 p.

Cox, F. A. 1921. A list of California Arachnida. III. The Scorpionida. Journal Entomology and Zoology Pomona College, 14:12-13.

Díaz Nájera, A. 1970. Contribución al conocimiento de los alacranes de México (Scorpionida). Revista de Investigación de Salud Publica, 30:111-122.

Ewing, H. E. 1928. The scorpions of the western part of the United States; with notes on those occurring in northern Mexico. Proceedings of the U. S. National Museum, 73(9):1-24.

Fet, V., W. D. Sissom, G. Lowe, and M. E. Braunwalder. 2000. Catalog of the Scorpions of the World (1758–1998). The New York Entomological Society, 690 p.

Fet, V., M. E. Soleglad, and M. S. Brewer. 2006. Laterobasal aculear serrations (LAS) in scorpion family Vaejovidae (Scorpiones: Chactoidea). Euscorpius, 45:1-19.

Fox, G. A., A. M. Cooper, and W. K. Hayes. 2013. The dilemma of choosing a reference character for measuring sexual size dimorphism, sexual body component dimorphism, and character scaling: cryptic dimorphism and allometry in the scorpion *Hadrurus arizonensis*. PLoS ONE, 10(3):e0120392. doi:10.1371/journal.pone.0120392.

Gertsch, W. J. 1958. Results of the Puritan-American Museum expedition to Western Mexico. 4. The scorpions. American Museum Novitates, 1903:1-20.

Gertsch, W. J. and D. M. Allred. 1965. Scorpions of the Nevada test site. Brigham Young University Science Bulletin, 6(4):1-15.

Harrison, S. 2013. Plant and animal endemism in California. University of California Press, California. 200 p.

Hjelle, J. T. 1972. Scorpions of the Northern Californian coast ranges. Occasional Papers of the California Academy of Sciences, 92:1-59.

Hjelle, J. T. 1990. Chapter 2: Anatomy and morphology, p. 9-63. *In*: The biology of scorpions. G. A. Polis (ed.). Stanford University Press, California. 587 p.

Humphries, J. M., F. L. Bookstein, B. Chernoff, G. R. Smith, R. L. Elder, and S. G. Poss. 1981. Multivariate discrimination by shape in relation to size. Systematic Biology, 30(3):291-308.

Johnson, J. D. & D. M. Allred. 1972. Scorpions of Utah. Great Basin Naturalist, 32(3):154-170.

Karsch, F. 1879b. Scorpionologische Beiträge. Part II. Mitteilungen des Münchener Entomologischen Vereins, 3:97-136.

Koch, L. E. 1978. A comparative study of the structure, function and adaptation to different habitats of burrows in the scorpion genus *Urodacus* (Scorpionida, Scorpionidae). Records of the Western Australian Museum, 6(2):119-146.

Kovarík, F. 1998c. Stiri. (Scorpions). Madagaskar, Jilhava. 175 pp.

Kraepelin, K. 1894. Revision der Scorpione. II. Scorpionidae und Bothriuridae. Beiheft zum Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten, 11:1-248.

Kraepelin, K. 1899. Skorpiones und Pedipalpi, pp. 1-265. *In*: Das Tierrich. F. E. Schultze (ed.). Friedlander, Berlin. Heft 8.

Küchler, A. W. 1947. Localizing vegetation terms. Annals of the Association of American Geographers, 37(4):197-208.

Lamoral, B. H. 1978. Soil hardness, an important limiting factor in burrowing scorpions of the genus *Opisthophthalmus* C. L. Koch, 1837 (Scorpionidae, Scorpionida). Symposium of the Zoological Society of London, 42:171-181.

Lowe, A., S. Harris, and P. Ashton. 2004. Ecological Genetics. Blackwell Publishing, Massachusetts. 326 p.

Lubischew, A. A. 1962. On use of discriminant functions in taxonomy. Biometrics, 18(4):455-477.

Marx, G. 1890a (Additional remarks regarding the types of the Scorpionidae described by Wood). Notes presented at the Meeting. Proceedings of the Entomological Society of Washington, 1(1884-1887):90-91.

McReynolds, C. N. 2008. Microhabitat preferences for the errant scorpion, *Centruroides vittatus* (Scorpiones, Buthidae). The Journal of Arachnology, 36(3):557-564.

Packard, G. C. and T. J. Boardman. 1987. Chapter 10: The misuse of ratios to scale physiological data that vary allometrically with body size, p. 216-239. *In*: New directions in ecological physiology. M. E. Feder, A. F. Bennett, W. W. Burggren, & R. B. Huey (eds.). Cambridge University Press, New York. 365 p.

Packard, G. C. and T. J. Boardman. 1988. The misuse of ratios, indices, and percentages in ecophysiological research. Physiological Zoology, 61(1):1-9.

Passmore, L. 1938. The scorpion and its young. Nature, 31:94–96.

Penther, A. 1913. Beitrag zur Kenntnis Amerikanischer Skorpione. Annalen des Kaiserlich-Königlichen Naturhistorischen Hofmuseums in Wien, 27:239-252.

Pocock, R. I. 1893b. Notes on the classification of scorpions, followed by some observations upon synonymy, with descriptions of new genera and species. Annals of Natural History, ser. 6, 12:303-330.

Pocock, R. I. 1902b. Arachnida, Scorpiones, Pedipalpi and Solifugae. Biologia Centrali-Americana. Taylor & Francis, London. 71 p.

Prendini, L. and W. C. Wheeler. 2005. Scorpion higher phylogeny and classification, taxonomic anarchy, and standards for peer review in online publishing. Cladistics, 21:446-494.

Raven, P. H. and D. I. Axelrod. 1978. Origin and relationships of the California flora. University of California Press, California. Vol. 72. 134 p.

Remington, C. L. 1968. Suture-zones of hybrid interaction between recently joined biotas, pp. 321–428. *In*: Evolutionary Biology. T. Dobzhansky, M. K. Hecht, & W. C. Steere (eds.). Plenum Press, New York.

Ricketts, T. H, E. Dinerstein, D. M. Olson, C. J. Loucks, W. Eichbaum, D. DellaSala, K. Kavanagh, P. Hedao, P. T. Hurley, K. M. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America: A conservation assessment. Island Press, Washington DC. 487 p.

Sissom, W. D., G. A. Polis, and D. D. Watt. 1990. Chapter 11: Field and laboratory methods, pp. 445–461. *In*: The biology of scorpions. G. A. Polis (ed.). Stanford University Press, Stanford, CA. 588 p.

Sissom, W.D. and V. Fet. 2000. Family Iuridae, pp. 503–553. *In*: Catalog of the scorpions of the world (1758–1998). V. Fet, W. D. Sissom, G. Lowe & M. E. Braunwalder (eds.). New York Entomological Society, New York. 690 p.

Stahnke, H. L. 1974b. Revision and keys to the higher categories of Vejovidae. Journal of Arachnology, 1(2):107-141.

Stahnke, H. L. 1976b. The determination of the type species of Diplocentrus (Scorpionida). Journal of the Arizona Academy of Sciences, 11(2):58-60.

Soleglad, M. E. and V. Fet. 2003a. High-level systematics and phylogeny of the extant scorpions (Scorpiones: Orthosterni). Euscorpius, 11:1-19.

Soleglad, M. E. and V. Fet. 2004. The systematics of the scorpion subfamily Uroctoninae (Scorpiones: Chactidae). Revista Ibérica de Aracnología, 10:81-128.

Soleglad, M. E. and V. Fet. 2005. The Genus *Auyantepuia* González-Sponga, 1978 is confirmed as a synonym of *Broteochactas* Pocock, 1893 (Scorpiones: Chactidae). Euscorpius, 29:1-14.

Soleglad, M. E. and V. Fet. 2008. Contributions to scorpion systematics. III. Subfamilies Smeringurinae and Syntropinae (Scorpiones: Vaejovidae). Euscorpius, 71:1-20.

Swenson, N. G. 2010. Mapping the suturing of a continental biota. Molecular Ecology, 19(24): 5324–5327.

Thorell, T. 1894. Scorpiones exotici R. Musei Historiae Naturalis Florentini. Bullettino della Societa Entomologica Italiana, 25:356-387.

Vachon, M. 1974. Étude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en Arachnologie, Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. Bulletin du Muséum National d'Histoire Naturelle, Paris, (3), 140 (Zool. 104), mai-juin 1973:857–958.

Volschenk, E. S. 2005. A new technique for examining surface morphosculpture scorpions. The Journal of Arachnology, 33:820-825.

Werner, F. 1934a. Scorpiones, pp. 1-316. *In*: Klassen und Ordnungen des Tierreichs. H. G. Bronn (ed.). Akad. Verlag, Leipzig. Bd. 5, Abt. 4, Buch 8 Lief 2, 512 p.

Werner, F. 1934b. Ergebnisse einer zoologischen Studien- und Sammelreise nach den Inseln des Agaischen Meeres. V. Arthropoden. Sitz.Ber. Akad. Wiss. Wien, 143:159-168.

Wheeler, Q. D. and N. I. Platnick. 2000. Chapter 5: The phylogenetic species concept (*sensu* Wheeler and Platnick). *In*: Species concepts and phylogenetic theory, p. 55-69. *In*: Species concepts and phylogenetic theory: a debate. Q. D. Wheeler & R. Meier (eds.). Columbia University Press, New York. 230 p.

Williams, S. C. 1966. Burrowing activities of the scorpion *Anuroctonus phaeodactylus* (Wood) (Scorpionida: Vejovidae). Proceedings of the California Academy of Sciences, ser. 4, 34(8):419-428.

Williams, S. C. 1968. Scorpion Preservation for Taxonomic and Morphological Studies. The Wasmann Journal of Biology, 26(1):133-136.

Williams, S. C. 1971b. Clarifications in the nomenclature of some North American Scorpionida. Pan-Pacific Entomologist, 47(1):78-79.

Williams, S. C. 1976. The scorpion fauna of California. Bulletin of the Society for Vector Ecology (Santa Ana, California), 3:14.

Williams, S. C. 1980. Scorpions of Baja California, Mexico and adjacent islands. Occasional Papers of the California Academy of Sciences, 135:1-127.

Wood, H. C. 1863. Description of new species of North American Pedipalpi. Proc. Acad. Nat. Sci. Philadelphia, 3:107-112.

Table 1. Assigned acronyms of populations examined to evaluate diagnosability of *A. p. pococki* in pectinal tooth counts, trichobothrial counts, and chela length/width.

| Acronym | Localities |
|---|---|
| MNT | Monterrey County |
| PIN | Pinnacles National Monument |
| BKR | Bakersfield |
| KRN | Banducci Road, Paradise Valley, Tehachapi Mts. |
| VEN | Ventura County |
| SGM | San Gabriel Mountains |
| SBM | San Bernardino Mountains |
| LOS | Los Angeles |
| DIB | Diamond Bar |
| CHI | Chino Hills |
| WIR | Weir Canyon |
| MOT | Motte Rimrock Reserve |
| RAT | Rattlesnake Reservoir |
| PNC | Pine Cove |
| LIM | Limestone Canyon, Irvine Ranch Conservancy |
| EDI | Edison Easement |
| STR | Starr Ranch |
| RAW | Rawson Valley |
| AWC | Aliso-Wood Canyon, Laguna Beach |
| ANZ | Anza |
| TEN | Tenaja Corridor 1, Tenaja Corridor 2 |
| SMR | Santa Margarita Ecological Reserve |
| SUN | Sunshine Summit |
| DLM | Dawson-Los Manos Reserve, SDG&E Access Road |
| WAP | Wild Animal Park |
| STY | Santa Ysabel Reserve |
| TOR | Torrey Pines 1, Torrey Pines 2, Torrey Pines 3 |
| DMM | Del Mar Mesa, Carmel Mountain |
| WCC | Wildcat Canyon |
| MIS | Mission Trails |
| CRE | La Cresta |
| DES | Descanso |
| SWT | San Diego Wildlife Refuge |
| CV2 | Chula Vista |
| TJE | Tijuana Estuary |
| SPR | Spring Canyon |
| MAR | Marron Valley |
| BCN | Baja California del Norte |

Table 2. Variables with significant discriminatory power found by stepwise procedure for a Discriminant Function Analysis on all populations analayzed in the *A. p. pococki* and *A. p. bajae* ranges. The character for infuscation of the digital carina is included along with the morphometric variables. Abbreviations: DigPig=pigmentation of the digital carina, Fem=pedipalp femur, Ch=pedipalp chela, FF=fixed finger, Tel=telson, Ves=vesicle, LegPat=leg patella, Ca=carapace, L=length, W=width, D=depth.

| Step | Character | Partial R-squared | F Value | Wilks' Lambda |
|---|---|---|---|---|
| 1 | DigPig | 0.9691 | 147.68 | 0.0309 |
| 2 | FemL/W | 0.4585 | 3.93 | 0.0167 |
| 3 | ChL/W | 0.3606 | 2.58 | 0.0107 |
| 4 | FFL/ChL | 0.3717 | 2.66 | 0.0067 |
| 5 | TelL/VesW | 0.3172 | 2.06 | 0.0045 |
| 6 | ChL/D | 0.2988 | 1.86 | 0.0032 |
| 7 | LegPatL/W | 0.2919 | 1.77 | 0.0022 |

Table 3. Variables with significant discriminatory power found by stepwise procedure for Discriminant Function Analysis on all populations in the ranges of *A. p. pococki* and *A. p. bajae*. The character for infuscation of the digital carina was excluded and only includes morphometrics. Abbreviations: Ch=pedipalp chela, FF=fixed finger, Tel=telson, Ves=vesicle, LegPat=leg patella, Ca=carapace, L=length, W=width, D=depth.

| **Step** | **Character** | **Partial R-squared** | **F Value** | **Wilks' Lambda** |
|---|---|---|---|---|
| 1 | ChL/W | 0.5895 | 6.77 | 0.4105 |
| 2 | FFL/ChL | 0.4870 | 4.41 | 0.2106 |
| 3 | ChL/D | 0.3415 | 2.37 | 0.1386 |
| 4 | LegPatL/W | 0.3348 | 2.27 | 0.0922 |
| 5 | TelL/VesW | 0.2984 | 1.88 | 0.0647 |
| 6 | FFL/CaL | 0.2832 | 1.72 | 0.0463 |
| 7 | ChW/D | 0.2711 | 1.59 | 0.0338 |

Table 4. Variables with significant discriminatory power found by stepwise procedure for Discriminant Function Analysis on all populations without infuscation of the digital carina. These populations are assigned to *A. p. bajae*. Populations included are C, D, F, I, and J. Abbreviations: Fem=pedipalp femur, Ch=pedipalp chela, FF=fixed finger, LegPat=leg patella, L=length, W=width.

| **Step** | **Character** | **Partial R-squared** | **F Value** | **Wilks' Lambda** |
|---|---|---|---|---|
| 1 | LegPatL/W | 0.3479 | 3.87 | 0.6520 |
| 2 | FemL/W | 0.5305 | 7.91 | 0.3061 |
| 3 | FFL/ChL | 0.4335 | 5.16 | 0.1734 |

Table 5. Variables with significant discriminatory power found by stepwise procedure for Discriminant Function Analysis on all populations without infuscation of the digital carina sans Population I. Population I was excluded due to ambiguity in its infuscation and color analysis. The remaining populations are assigned to *A. p. bajae*. Populations included are C, D, F, and J. Abbreviations: Fem=pedipalp femur, LegPat=leg patella, L=length, W=width.

| **Step** | **Character** | **Partial R-squared** | **F Value** | **Wilks' Lambda** |
|---|---|---|---|---|
| 1 | FemL/W | 0.3430 | 4.35 | 0.6570 |
| 2 | LegPatL/W | 0.3712 | 4.72 | 0.4131 |

Table 6. Variables with significant discriminatory power found by stepwise procedure for Discriminant Function Analysis on all populations with infuscation of the digital carina. These populations are assigned as *A. p. pococki*. Populations included are A, B, E, G, H, K, L, M, N, O, and P. Abbreviations: Fem=pedipalp femur, Ch=pedipalp chela, FF=fixed finger, Ca=carapace, L=length, W=width, D=depth.

| **Step** | **Character** | **Partial R-squared** | **F Value** | **Wilks' Lambda** |
|---|---|---|---|---|
| 1 | ChL/W | 0.5939 | 6.01 | 0.4060 |
| 2 | FFL/ChL | 0.5302 | 4.51 | 0.1907 |
| 3 | ChL/D | 0.3722 | 2.31 | 0.1197 |
| 4 | FFL/CaL | 0.3752 | 2.27 | 0.0748 |
| 5 | FemL/W | 0.3487 | 1.96 | 0.0487 |

Table 7. Variables with significant discriminatory power found by stepwise procedure for Discriminant Function Analysis on all populations with infuscation of the digital carina sans Population P. Population P was removed because it was reevaluated and found to be *A. phaiodactylus*, thus violating the objective of this DFA. These populations are assigned to *A. p. pococki.* Populations included are A, B, E, G, H, K, L, M, N, and O. Abbreviations: Fem=pedipalp femur, Ch=pedipalp chela, FF=fixed finger, Tel=telson, Ves=vesicle, Ca=carapace, MetV=metasoma V, L=length, W=width, D=depth.

| **Step** | **Character** | **Partial R-squared** | **F Value** | **Wilks' Lambda** |
|---|---|---|---|---|
| 1 | ChL/W | 0.5939 | 6.76 | 0.4060 |
| 2 | FFL/ChL | 0.3696 | 2.64 | 0.2560 |
| 3 | ChL/D | 0.3709 | 2.58 | 0.1610 |
| 4 | FFL/CaL | 0.3141 | 1.95 | 0.1104 |
| 5 | FemL/W | 0.3364 | 2.09 | 0.0733 |
| 6 | TelL/VesW | 0.3318 | 1.99 | 0.0489 |
| 7 | MetVL/W | 0.3041 | 1.69 | 0.0340 |

Table 8. Populations of *A. p. pococki* for evaluated for their variable patterns of infuscation on carapace, tergites, pedipalp femurs, and metasoma I-V. These patterns were used to evaluate diagnosability in *A. p. pococki*. Key: Pattern 1=carapace, pedipalp femur, tergites, and all metasoma always infuscate; Pattern 2=carapace, tergites, and all metasoma always infuscate, pedipalp femurs variable; Pattern 3=carapace, tergites, and metasoma IV-V always infuscate, metasoma I-III and pedipalp femurs variable; Pattern 4=carapace, tergites, metasoma IV-V always infuscate, metasoma I-III variable, pedipalp femurs never infuscate; Pattern 5=tergites and all metasoma always infuscate, carpace and pedipalp femurs never infuscate; Pattern 6=tergites and metasoma IV-V always infuscate, metasoma III variable, all others never infuscate; Pattern 7=infuscation limited to tergites and metasoma V; Pattern 8=infuscation limited to tergites. See Table 1 for acronym definitions.

| **Population** | **Pattern 1** | **Pattern 2** | **Pattern 3** | **Pattern 4** | **Pattern 5** | **Pattern 6** | **Pattern 7** | **Pattern 8** |
|---|---|---|---|---|---|---|---|---|
| DMM | X | | | | | | | |
| DLM | X | | | | | | | |
| SMR | X | | | | | | | |
| WCC | X | | | | | | | |
| TEN | X | X | | | | | | |
| CHI | X | | | | | | | |
| CRE | | X | | | | | | |
| MOT | | X | | | | | | |
| DIB | | X | | | | | | |
| TUL | | X | | | | | | |
| SUN | | X | | | | | | |
| LIM | | X | | X | | | | |
| EDI | | X | | | | | | |
| TOR | | | X | | | | | |
| MAR | | | X | | | | | |
| SPR | | | X | | | | | |
| AWC | | | X | | | | | X |

Table 8 continued.

| Population | Pattern 1 | Pattern 2 | Pattern 3 | Pattern 4 | Pattern 5 | Pattern 6 | Pattern 7 | Pattern 8 |
|---|---|---|---|---|---|---|---|---|
| RAW | | | X | | | | | |
| SWT | | | X | | | | | |
| RAT | | | | X | | | | |
| KRN | | | | X | | | | |
| CV2 | | | | X | | | | |
| WIR | | | | X | | | | |
| WAP | | | | X | | | | |
| STR | | | | X | | | | |
| TJE | | | | X | | | | |
| BKR | | | | | X | | | |
| PIN | | | | | | X | | |
| SGM | | | | | | | X | |

Table 9. Pectinal tooth count ranges, mean, standard deviation, and modes for males and females in each population of *A. p. pococki*. These counts were used to evaluate diagnosability in populations of *A. p. pococki*. Sample size *n* refers to the number of combs. St. Dev = standard deviation. See Table 1 for acronym definitions.

| **Population** | **Males** | | | | | **Females** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| MNT | 7-9 | 8.50 | 9 | 0.84 | 6 | 6-7 | 6.67 | 7 | 0.52 | 6 |
| PIN | 7-9 | 8.10 | 8 | 0.72 | 20 | 6-7 | 6.50 | 6,7 | 0.55 | 6 |
| TUL | 8 | 8.00 | 8 | 0.00 | 2 | - | - | - | - | - |
| BKR | - | - | - | - | - | 5-6 | 5.50 | 5,6 | 0.58 | 4 |
| KRN | 7-9 | 8.25 | 8 | 0.71 | 8 | 6-8 | 7.13 | 7 | 0.64 | 8 |
| VEN | 9-10 | 9.25 | 9 | 0.50 | 4 | 7-8 | 7.50 | 7,8 | 0.58 | 4 |
| SGM | 5-10 | 8.06 | 8 | 1.12 | 16 | 6-8 | 6.88 | 7 | 0.64 | 8 |
| SBM | 6-10 | 8.50 | 8,10 | 1.52 | 6 | - | - | - | - | - |
| LOS | 9 | 9.00 | 9 | 0.00 | 2 | 7-8 | 7.50 | - | 0.71 | 2 |
| DIB | 8-10 | 9.25 | 10 | 0.96 | 4 | 7-8 | 7.13 | 7 | 0.35 | 8 |
| CHI | 9-11 | 9.35 | 9 | 0.59 | 20 | 6-8 | 7.50 | 8 | 0.67 | 12 |
| WIR | 7-10 | 8.80 | 8,9,10 | 1.03 | 10 | 6 | 6 | 6 | 0.00 | 2 |
| MOT | 7-10 | 8.00 | 8 | 0.94 | 10 | - | - | - | - | - |
| RAT | 7-11 | 8.94 | 9 | 1.00 | 16 | 7 | 7 | 7 | 0.00 | 2 |
| PNC | - | - | - | - | - | 6-7 | 6.75 | 7 | 0.50 | 4 |
| LIM | 8-10 | 9.25 | 9 | 0.64 | 20 | 7-8 | 7.46 | 7 | 0.53 | 7 |
| EDI | 8-10 | 9.17 | 10 | 0.98 | 6 | - | - | - | - | - |
| STR | 8-11 | 9.61 | 9 | 0.85 | 18 | 7-8 | 7.25 | 7 | 0.50 | 4 |

Table 9 continued.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | Mean | Mode | St. Dev | *n* | Range | Mean | Mode | St. Dev | *n* |
| RAW | 6-9 | 7.85 | 7 | 0.99 | 20 | - | - | - | - | - |
| AWC | 7-11 | 8.67 | 8 | 0.99 | 27 | 6-8 | 7.17 | 7 | 0.58 | 12 |
| ANZ | 7-8 | 7.50 | 7,8 | 0.58 | 4 | 6-7 | 6.50 | 6,7 | 0.58 | 4 |
| TEN | 6-9 | 8.29 | 9 | 0.78 | 25 | 6-8 | 7.00 | 7 | 0.76 | 8 |
| SMR | 7-10 | 8.71 | 9 | 0.99 | 14 | 6-9 | 7.32 | 7 | 0.78 | 22 |
| SUN | 8-9 | 7.50 | - | 0.71 | 2 | 5-7 | 6.14 | 6 | 0.64 | 15 |
| DLM | 7-10 | 8.50 | - | 1.29 | 4 | 5-9 | 6.80 | 7 | 0.95 | 20 |
| WAP | 6-9 | 7.78 | 8 | 0.81 | 18 | 5-7 | 5.75 | 5 | 0.96 | 4 |
| STY | 8-10 | 8.67 | 8 | 0.82 | 6 | 6-7 | 6.50 | 6,7 | 0.53 | 10 |
| TOR | 5-9 | 7.71 | 7 | 1.05 | 20 | 5-7 | 6.50 | 7 | 0.92 | 8 |
| DMM | 6-9 | 7.72 | 8 | 0.88 | 30 | 6-8 | 6.62 | 7 | 0.78 | 34 |
| WCC | 7-9 | 8.00 | 8 | 0.76 | 8 | 5-7 | 6.00 | 5,7 | 1.15 | 4 |
| MIS | 6-9 | 7.50 | 8 | 0.76 | 20 | - | - | - | - | - |
| CRE | 6-9 | 7.77 | 8 | 0.81 | 22 | - | - | - | - | - |
| DES | 8-9 | 8.50 | - | 0.55 | 6 | 6-7 | 6.50 | - | 0.71 | 2 |
| SWT | 6-10 | 7.75 | 7 | 1.24 | 16 | 6 | 6 | 6 | 0.00 | 2 |
| CV2 | 9-10 | 9.33 | 9 | 0.52 | 6 | 6-7 | 6.75 | 7 | 0.50 | 4 |
| TJE | 7-9 | 8.17 | 8 | 0.62 | 18 | 5 | 5 | 5 | 0.00 | 2 |
| SPR | 7-10 | 8.45 | 8 | 0.69 | 20 | 7-8 | 7.50 | - | 0.71 | 2 |
| MAR | 7-8 | 7.85 | 8 | 0.55 | 13 | 7 | 7 | 7 | 0.00 | 4 |
| BCN | 8-11 | 8.83 | 8 | 0.82 | 24 | 6-8 | 6.67 | 6 | 0.82 | 6 |

Table 10. Trichobothria ranges, means, standard deviations, and modes on the ventroexternal carina on the pedipalp chela. Males and females reported separately and by population of *A. p. pococki*. Counts were used to evaluate diagnosability and geographic variation. Where *n* refers to the number of chela. St. Dev = standard deviation.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| MNT | 14-20 | 16.67 | - | 2.16 | 6 | 17-20 | 18.17 | 17,18 | 1.17 | 6 |
| PIN | 16-20 | 18.20 | 18 | 1.11 | 20 | 17-18 | 17.50 | 17,18 | 0.55 | 6 |
| TUL | 17 | 17 | 17 | 0.00 | 2 | - | - | - | - | - |
| BKR | - | - | - | - | - | 19-22 | 20.50 | - | 1.29 | 4 |
| KRN | 17-19 | 18.00 | 17,18 | 0.93 | 8 | 18-22 | 19.25 | 18,19 | 1.49 | 8 |
| VEN | 17-20 | 19.00 | 20 | 1.41 | 4 | 16-18 | 17.00 | 16 | 0.96 | 4 |
| SGM | 15-19 | 16.56 | 16,17 | 1.15 | 16 | 16-18 | 17.13 | 17,18 | 0.83 | 8 |
| SBM | 14-17 | 15.67 | 17 | 1.51 | 6 | - | - | - | - | - |
| LOS | 19 | 19.00 | 19 | 0.00 | 2 | 18-19 | 18.50 | - | 0.71 | 2 |
| DIB | 17-20 | 18.75 | 19 | 1.26 | 4 | 17-21 | 19.38 | 19,20 | 1.19 | 8 |
| CHI | 17-21 | 19.05 | 19 | 1.28 | 20 | 17-20 | 18.12 | 17 | 1.19 | 13 |
| WIR | 17-21 | 18.70 | 18 | 1.16 | 10 | 20-21 | 20.50 | - | 0.71 | 2 |
| MOT | 19-27 | 21.90 | 22 | 2.60 | 10 | - | - | - | - | - |
| RAT | 17-20 | 18.31 | 17,18 | 1.20 | 16 | 18-19 | 18.50 | - | 0.71 | 2 |
| PNC | - | - | - | - | - | 15-18 | 16.50 | - | 1.29 | 4 |
| LIM | 17-20 | 18.20 | 18 | 0.95 | 20 | 18-20 | 18.88 | 19 | 0.64 | 8 |
| EDI | 17-18 | 17.67 | 18 | 0.52 | 6 | - | - | - | - | - |
| STR | 18-21 | 19.44 | 20 | 1.04 | 18 | 18-21 | 19.75 | 20 | 1.26 | 4 |

Table 10 continued.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| RAW | 18-24 | 20.95 | 22 | 1.76 | 20 | - | - | - | - | - |
| AWC | 16-22 | 18.04 | 18 | 1.54 | 27 | 15-19 | 17.92 | 18 | 1.17 | 12 |
| ANZ | 17-18 | 17.25 | 17 | 0.50 | 4 | 16-18 | 17.00 | 17 | 0.82 | 4 |
| TEN | 17-25 | 20.41 | 21 | 2.11 | 26 | 19-23 | 21.33 | 22 | 1.37 | 6 |
| SMR | 17-23 | 20.07 | 20 | 1.54 | 14 | 18-27 | 20.50 | 19 | 2.24 | 22 |
| SUN | 20-22 | 21.00 | - | 1.41 | 2 | 15-19 | 17.19 | 17 | 1.28 | 16 |
| DLM | 17 | 17.00 | 17 | 0.00 | 4 | 16-23 | 18.50 | 17 | 1.91 | 20 |
| WAP | 16-20 | 18.44 | 19 | 1.25 | 18 | 17-18 | 17.50 | 17,18 | 0.58 | 4 |
| STY | 17-19 | 17.67 | 17 | 0.82 | 6 | 17-20 | 18.40 | 17,19 | 1.17 | 10 |
| TOR | 13-17 | 15.50 | 16 | 1.11 | 30 | 13-17 | 15.63 | 16 | 1.40 | 7 |
| DMM | 16-19 | 17.20 | 17 | 0.81 | 30 | 15-20 | 16.48 | 15 | 1.43 | 31 |
| WCC | 18-19 | 18.50 | - | 0.53 | 8 | 17-19 | 18.33 | 19 | 1.15 | 3 |
| MIS | 16-20 | 18.30 | 18 | 1.08 | 20 | - | - | - | - | - |
| CRE | 16-23 | 19.18 | 18 | 1.71 | 22 | - | - | - | - | - |
| DES | 17-19 | 18.17 | 19 | 0.98 | 6 | 17-20 | 18.50 | - | 2.12 | 2 |
| SWT | 16-20 | 18.33 | 20 | 1.50 | 18 | 18 | 18.00 | 18 | 0.00 | 2 |
| CV2 | 15-21 | 18.08 | 18,19 | 1.56 | 12 | 18-22 | 20.25 | 22 | 2.06 | 4 |
| TJE | 15-20 | 17.46 | 17 | 1.12 | 17 | 17 | 17.00 | 17 | 0.00 | 2 |
| SPR | 17-21 | 19.35 | 19 | 1.31 | 20 | 18-19 | 18.50 | - | 0.71 | 2 |
| MAR | 18-23 | 19.50 | 19 | 1.22 | 14 | 16-18 | 17.25 | 18 | 0.96 | 4 |
| BCN | 14-18 | 16.33 | 16,17,18 | 1.43 | 23 | 14-18 | 15.67 | 14 | 1.82 | 5 |

Table 11. Trichobothria ranges, means, standard deviations, and modes on the ventroexternal carinae on the pedipalp patella. Males and females were reported separately and by population of *A. p. pococki*. Counts were used to evaluate diagnosability and geographic variation. Where *n* refers to the number of patella. St. Dev = standard deviation.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| MNT | 12-14 | 12.83 | 13 | 0.75 | 6 | 12-14 | 13.00 | 12,13,14 | 0.89 | 6 |
| PIN | 10-14 | 12.60 | 14 | 1.51 | 10 | 11-15 | 13.00 | 13 | 1.33 | 6 |
| TUL | - | - | - | - | - | - | - | - | - | - |
| BKR | - | - | - | - | - | 13-14 | 13.25 | 13 | 0.50 | 4 |
| KRN | 11-13 | 12.00 | - | 1.41 | 2 | 12-14 | 12.83 | 13 | 0.75 | 6 |
| VEN | 14 | 14.00 | 14 | 0.00 | 4 | 11-15 | 13.00 | 13 | 1.63 | 4 |
| SGM | 12-16 | 13.38 | 13,14 | 1.15 | 16 | 13-15 | 13.50 | 13 | 0.84 | 6 |
| SBM | 12-13 | 12.17 | 12 | 0.41 | 6 | - | - | - | - | - |
| LOS | 14 | 14.00 | 14 | 0.00 | 2 | 14 | 14.00 | - | - | 1 |
| DIB | - | - | - | - | - | - | - | - | - | - |
| CHI | - | - | - | - | - | - | - | - | - | - |
| WIR | 12-15 | 14.10 | 15 | 1.29 | 10 | 12 | 12.00 | 12 | 0.00 | 2 |
| MOT | 13-18 | 15.50 | 15,16,17 | 1.58 | 10 | - | - | - | - | - |
| RAT | 14-16 | 14.50 | 14 | 1.00 | 4 | - | - | - | - | - |
| PNC | - | - | - | - | - | 11-12 | 11.50 | 11,12 | | 4 |
| LIM | 13-15 | 13.70 | 14 | 0.67 | 10 | 12-16 | 14.54 | 15 | 1.51 | 7 |
| EDI | 13-14 | 13.17 | 13 | 0.41 | 6 | - | - | - | - | - |
| STR | 12-15 | 13.50 | 13,14 | 1.08 | 10 | 13-14 | 13.50 | 13,14 | 0.71 | 2 |

Table 11 continued.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| RAW | 13-16 | 14.60 | 14,15 | 0.97 | 10 | - | - | - | - | - |
| AWC | 12-16 | 13.25 | 13 | 1.14 | 14 | 12-15 | 13.58 | 14 | 0.88 | 9 |
| ANZ | 12-14 | 13.00 | 13 | 0.82 | 4 | 12-14 | 13.00 | 13 | 0.82 | 4 |
| TEN | 12-16 | 13.83 | 13 | 1.47 | 6 | - | - | - | - | - |
| SMR | - | - | - | - | - | - | - | - | - | - |
| SUN | 14-16 | 15.00 | - | 1.41 | 2 | 13-16 | 14.44 | 13,16 | 1.26 | 16 |
| DLM | - | - | - | - | - | - | - | - | - | - |
| WAP | 12-15 | 13.30 | 13 | 1.06 | 10 | 14-17 | 15.50 | - | 1.29 | 4 |
| STY | 13-14 | 13.25 | 13 | 0.50 | 4 | 12-14 | 12.50 | 12 | 0.85 | 10 |
| TOR | 10-14 | 11.94 | 12 | 1.06 | 16 | 8-12 | 11.00 | 12 | 2.31 | 3 |
| DMM | 12-14 | 13.00 | 12,14 | 0.94 | 10 | 11-16 | 13.00 | 12,13 | 1.58 | 9 |
| WCC | - | - | - | - | - | - | - | - | - | - |
| MIS | 12-15 | 13.68 | 14 | 0.87 | 9 | - | - | - | - | - |
| CRE | 12-15 | 13.90 | 14 | 0.99 | 10 | - | - | - | - | - |
| DES | 12-15 | 13.17 | 13 | 0.98 | 6 | 14 | 14.00 | 14 | 0.00 | 2 |
| SWT | 12-15 | 13.80 | 13,15 | 1.03 | 10 | 14 | 14.00 | 14 | 0.00 | 2 |
| CV2 | 11-14 | 13.20 | 13 | 1.14 | 10 | 12-14 | 13.25 | 13 | 1.26 | 4 |
| TJE | 10-13 | 11.89 | 12,13 | 1.05 | 9 | 12-13 | 12.50 | - | 0.71 | 2 |
| SPR | 11-15 | 13.18 | 13 | 1.30 | 9 | 13 | 13.00 | 13 | 0.00 | 2 |
| MAR | 11-16 | 13.50 | 12-15 | 1.58 | 10 | 13-15 | 14.00 | 14 | 0.82 | 4 |
| BCN | 11-14 | 12.90 | 14 | 1.10 | 10 | 10-12 | 10.75 | - | 1.00 | 3 |

Table 12. Trichobothria ranges, means, standard deviations, and modes on the pedipalp patella wrap around arc on the external face. Males and females reported separately and by population of *A. p. pococki*. Counts were used to evaluate diagnosability and geographic variation. Where *n* refers to the number of patella. St. Dev = standard deviation.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** | **Range** | **Mean** | **Mode** | **St. Dev** | ***n*** |
| MNT | 5-9 | 6.67 | 5 | 1.63 | 6 | 5-8 | 6.58 | 7 | 1.14 | 5 |
| PIN | 6-9 | 6.88 | 6 | 1.36 | 8 | 7-10 | 8.17 | 7,8 | 1.17 | 6 |
| TUL | - | - | - | - | - | - | - | - | - | - |
| BKR | - | - | - | - | - | 6-9 | 7.50 | - | | 4 |
| KRN | 7-9 | 8.00 | - | 1.41 | 2 | 5-9 | 6.67 | 5 | 1.67 | 5 |
| VEN | 7 | 7.00 | 7 | 0.00 | 4 | 7-10 | 9.25 | 10 | 1.73 | 3 |
| SGM | 6-9 | 7.00 | 7 | 1.04 | 14 | 5-8 | 6.50 | 6 | 1.05 | 6 |
| SBM | 5-7 | 5.67 | 5 | 0.82 | 6 | - | - | - | - | - |
| LOS | 7-8 | 7.50 | - | 0.71 | 2 | 7-8 | 7.50 | - | 0.71 | 2 |
| DIB | - | - | - | - | - | - | - | - | - | - |
| CHI | - | - | - | - | - | - | - | - | - | - |
| WIR | 7-10 | 8.90 | 9 | 0.99 | 10 | 9-10 | 9.50 | - | 0.71 | 2 |
| MOT | 6-9 | 7.50 | 7 | 0.85 | 10 | - | - | - | - | - |
| RAT | 7-9 | 8.00 | 8 | 0.82 | 4 | - | - | - | - | - |
| PNC | - | - | - | - | - | 5-7 | 5.67 | 5 | | 4 |
| LIM | 6-9 | 7.50 | 7,8 | 0.85 | 10 | 6-9 | 7.63 | 8 | 0.98 | 7 |
| EDI | 6-9 | 7.33 | 7 | 1.03 | 6 | - | - | - | - | - |
| STR | 6-10 | 7.90 | 8 | 1.10 | 10 | 7-8 | 7.50 | 7,8 | 0.58 | 4 |

Table 12 continued.

| Population | Males | | | | | Females | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | Mean | Mode | St. Dev | *n* | Range | Mean | Mode | St. Dev | *n* |
| RAW | 5-8 | 6.60 | 7 | 1.07 | 10 | - | - | - | - | - |
| AWC | 6-9 | 7.23 | 8 | 1.03 | 12 | 6-9 | 7.73 | 9 | 1.09 | 9 |
| ANZ | 6-7 | 6.25 | 6 | 0.50 | 4 | 5-7 | 5.75 | - | 1.00 | 3 |
| TEN | 6-8 | 7.41 | 8 | 0.79 | 7 | - | - | - | - | - |
| SMR | - | - | - | - | - | - | - | - | - | - |
| SUN | 6 | 6.00 | 6 | 0.00 | 2 | 5-8 | 6.31 | 6 | 0.87 | 16 |
| DLM | - | - | - | - | - | - | - | - | - | - |
| WAP | 6-8 | 7.10 | 7 | 0.74 | 10 | 7-9 | 7.75 | 7 | 0.96 | 4 |
| STY | 6-7 | 6.17 | 6 | 0.45 | 5 | 7-8 | 7.50 | 8 | 0.53 | 8 |
| TOR | 4-7 | 5.06 | 4 | 1.00 | 16 | 4-7 | 5.25 | - | 1.53 | 3 |
| DMM | 5-7 | 6.20 | 6,7 | 0.79 | 10 | 5-8 | 6.45 | 6 | 0.88 | 9 |
| WCC | - | - | - | - | - | - | - | - | - | - |
| MIS | 6-8 | 6.70 | 6 | 0.95 | 10 | - | - | - | - | - |
| CRE | 6-8 | 6.95 | 6,7,8 | 0.87 | 9 | - | - | - | - | - |
| DES | 6-9 | 7.17 | 7 | 0.98 | 6 | 6-7 | 6.50 | - | 0.71 | 2 |
| SWT | 5-9 | 7.30 | 8 | 1.34 | 10 | 8 | 8.00 | 8 | 0.00 | 2 |
| CV2 | 6-8 | 6.67 | 6 | 0.78 | 12 | 7 | 7.00 | 7 | 0.00 | 2 |
| TJE | 5-9 | 6.33 | 6 | 1.12 | 9 | 5-7 | 6.00 | 6 | 1.41 | 2 |
| SPR | 5-9 | 6.90 | 7 | 1.17 | 9 | 5-7 | 6.00 | - | 1.41 | 2 |
| MAR | 6-9 | 7.80 | 8 | 0.92 | 10 | 5-8 | 6.25 | 6 | 1.26 | 4 |
| BCN | 5-8 | 6.75 | 6.75 | 0.79 | 10 | 6-7 | 6.75 | 6.75 | 0.58 | 3 |

Table 13. Morphometrics of sexually mature males from populations used in the DFA were examined in a single variable context for diagnosibility and geographic variation. Abbreviations: Ch=chela, Fem=pedipalp femur, MF=moveable finger, FF=fixed finger, Ca=carapace, MetI=metasoma I, MetV=metasoma V, Tel=telson, Ves=telson vesicle, L=length, W=width, D=depth.

| Population | ChL/W | ChL/D | ChW/D | FemL/W | MFL/ChW | FFL/CaL | MetIL/W |
|---|---|---|---|---|---|---|---|
| **A** | 2.83-3.21 | 2.33-2.91 | 0.78-0.95 | 1.92-2.42 | 1.61-1.81 | 0.53-0.67 | 0.65-0.89 |
| **B** | 2.68-3.07 | 2.13-2.49 | 0.75-0.88 | 2.00-2.35 | 1.52-1.76 | 0.58-0.66 | 0.71-0.83 |
| **C** | 2.99-3.56 | 2.45-2.70 | 0.76-0.86 | 2.22-3.07 | 1.62-2.05 | 0.63-0.83 | 0.74-0.85 |
| **D** | 2.97-3.04 | 2.39-2.85 | 0.77-0.85 | 2.26-2.50 | 1.51-1.96 | 0.63-0.73 | 0.71-0.84 |
| **E** | 2.57-2.88 | 2.18-2.40 | 0.81-0.87 | 2.00-2.42 | 1.45-1.69 | 0.53-0.67 | 0.72-0.76 |
| **F** | 2.88-3.26 | 2.31-2.57 | 0.75-0.85 | 2.17-2.36 | 1.63-1.93 | 0.61-0.79 | 0.74-0.84 |
| **G** | 2.91-3.24 | 2.35-2.64 | 0.78-0.84 | 2.13-2.44 | 1.65-2.02 | 0.63-0.77 | 0.72-0.83 |
| **H** | 2.71-3.15 | 2.34-2.58 | 0.78-0.86 | 2.21-2.38 | 1.63-1.86 | 0.66-0.74 | 0.70-0.76 |
| **I** | 3.00-3.27 | 2.45-2.71 | 0.80-0.90 | 2.26-2.54 | 1.63-1.86 | 0.63-0.72 | 0.71-0.82 |
| **J** | 3.14-3.44 | 2.41-2.68 | 0.76-0.81 | 2.39-2.52 | 1.77-1.95 | 0.67-0.71 | 0.75-0.82 |
| **K** | 3.18 | 2.55 | 0.80 | 2.46 | 1.80 | 0.65 | 0.74 |
| **L** | 3.00-3.19 | 2.44-2.73 | 0.79-0.85 | 2.29-2.42 | 1.70-1.87 | 0.64-0.72 | 0.73-0.78 |
| **M** | 2.80-2.84 | 2.35-2.45 | 0.84-0.86 | 2.09-2.19 | 1.45-1.65 | 0.65-0.66 | 0.72-0.75 |
| **N** | 2.98 | 2.39 | 0.80 | 2.20 | 1.78 | 0.69 | 0.68 |
| **O** | 2.94-3.00 | 2.34-2.44 | 0.80-0.81 | 2.10-2.21 | 1.75-1.77 | 0.68-0.71 | 0.71-0.72 |
| **P** | 2.95 | 2.34 | 0.79 | 2.41 | 1.75 | 0.72 | 0.75 |

Table 13 continued.

| Population | MetVL/W | FFL/ChL | CaL/MetVL | TelL/VesD | TelL/VesW | MetVW/VesW |
|---|---|---|---|---|---|---|
| **A** | 3.12-3.53 | 0.35-0.43 | 1.09-1.44 | 1.93-2.37 | 2.20-2.54 | 0.61-0.78 |
| **B** | 3.04-3.85 | 0.37-0.45 | 0.98-1.23 | 2.02-2.47 | 2.16-2.64 | 0.68-0.83 |
| **C** | 2.92-3.33 | 0.40-0.69 | 1.09-1.21 | 2.36-2.70 | 2.17-2.64 | 0.67-0.79 |
| **D** | 2.91-3.88 | 0.40-0.44 | 1.09-1.33 | 2.31-2.59 | 2.43-2.62 | 0.65-0.79 |
| **E** | 2.65-3.22 | 0.34-0.42 | 1.10-1.37 | 2.02-2.55 | 2.13-2.62 | 0.65-0.76 |
| **F** | 2.82-3.45 | 0.39-0.50 | 1.15-1.29 | 2.18-2.50 | 2.40-2.57 | 0.68-0.76 |
| **G** | 3.10-3.57 | 0.39-0.46 | 1.07-1.23 | 2.17-2.50 | 2.28-2.60 | 0.67-0.78 |
| **H** | 2.94-3.41 | 0.39-0.44 | 1.09-1.30 | 2.05-2.57 | 2.22-2.57 | 0.64-0.79 |
| **I** | 2.96-3.33 | 0.39-0.42 | 1.15-1.24 | 2.24-2.49 | 2.29-2.61 | 0.66-0.78 |
| **J** | 3.04-3.38 | 0.41-0.44 | 1.11-1.22 | 2.19-2.46 | 2.31-2.57 | 0.68-0.73 |
| **K** | 3.09 | 0.39 | 1.20 | 2.38 | 2.45 | 0.74 |
| **L** | 3.19-3.22 | 0.39-0.44 | 1.12-1.14 | 2.24-2.36 | 2.65-2.71 | 0.76-0.79 |
| **M** | 3.14-3.26 | 0.39-0.43 | 1.14-1.15 | 2.41-2.54 | 2.37-2.55 | 0.70 |
| **N** | 2.96 | 0.43 | 1.19 | 2.23 | 2.26 | 0.70 |
| **O** | 3.00-3.45 | 0.42-0.44 | 1.14-1.25 | 2.25-2.49 | 2.34-2.61 | 0.67-0.71 |
| **P** | 3.33 | 0.50 | 1.23 | 2.47 | 2.39 | 0.68 |

Table 14. Descriptive morphometrics of *A. bajae* and *A. pococki* males reported in the species desciptions. Abbreviations: Ch=pedipalp chela, Fem=pedipalp femur, MF=moveable finger, FF=fixed finger, Ca=carapace, MetI=metasoma I, MetV=metasoma V, Tel=telson, Ves=telson vesicle, LegPat=leg IV patella, L=length, W=width, D=depth.

| **Character** | ***bajae*** | ***pococki*** |
|---|---|---|
| | **Range** | **Range** |
| ChL/W | 2.88-3.56 | 2.57-3.24 |
| ChL/D | 2.31-2.71 | 2.13-2.91 |
| ChW/D | 0.75-0.86 | 0.75-0.95 |
| FemL/W | 2.17-3.07 | 1.92-2.46 |
| MFL/ChW | 1.62-2.05 | 1.45-2.02 |
| FFL/CaL | 0.61-0.83 | 0.53-0.77 |
| MetIL/W | 0.71-0.85 | 0.65-0.89 |
| MetVL/W | 2.82-3.45 | 2.65-3.85 |
| FFL/ChL | 0.39-0.69 | 0.34-0.46 |
| CaL/MetVL | 1.09-1.29 | 0.98-1.44 |
| TelL/VesD | 2.18-2.70 | 1.93-2.57 |
| TelL/VesW | 2.17-2.64 | 2.13-2.71 |
| MetVW/VesW | 0.66-0.79 | 0.61-0.83 |
| LegPatL/W | 2.19-2.88 | 2.25-3.29 |

Figure 1. *Anuroctonus* mature male from James San Jacinto Mountain Reserve in Riverside County, California, USA.

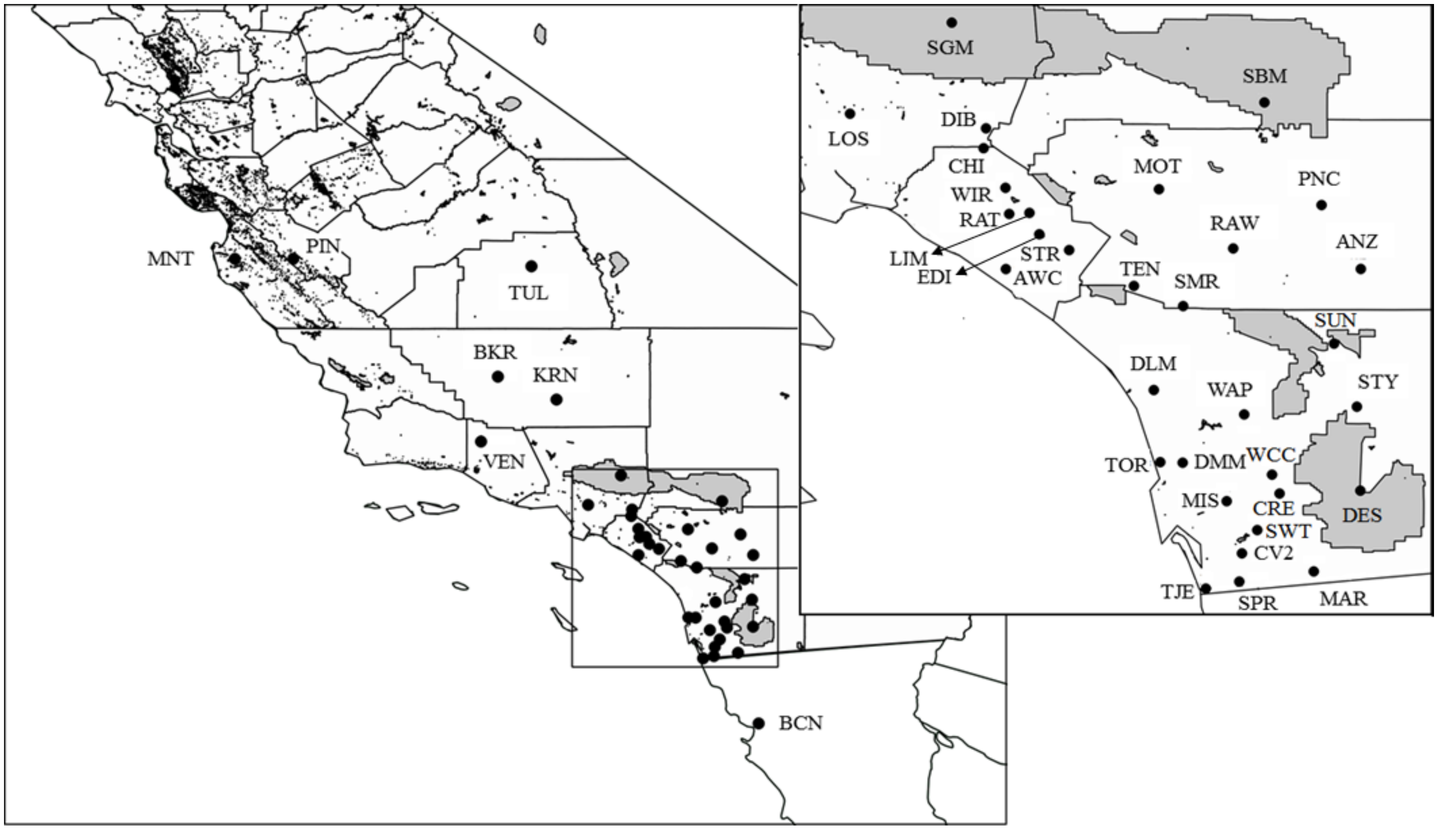


Figure 2. Populations on A. p. pococki in southern California and Baja California Norte used to examine diagnosability and geographic variation in pectinal tooth counts, trichobothrial counts, and morphometrics. See Table 1 for definitions of acronyms. Black lines are county, state, and national borders. Dark grey shaded areas are mountain ranges or bodies of water. Inset light grey shaded box is expanded to right of map.

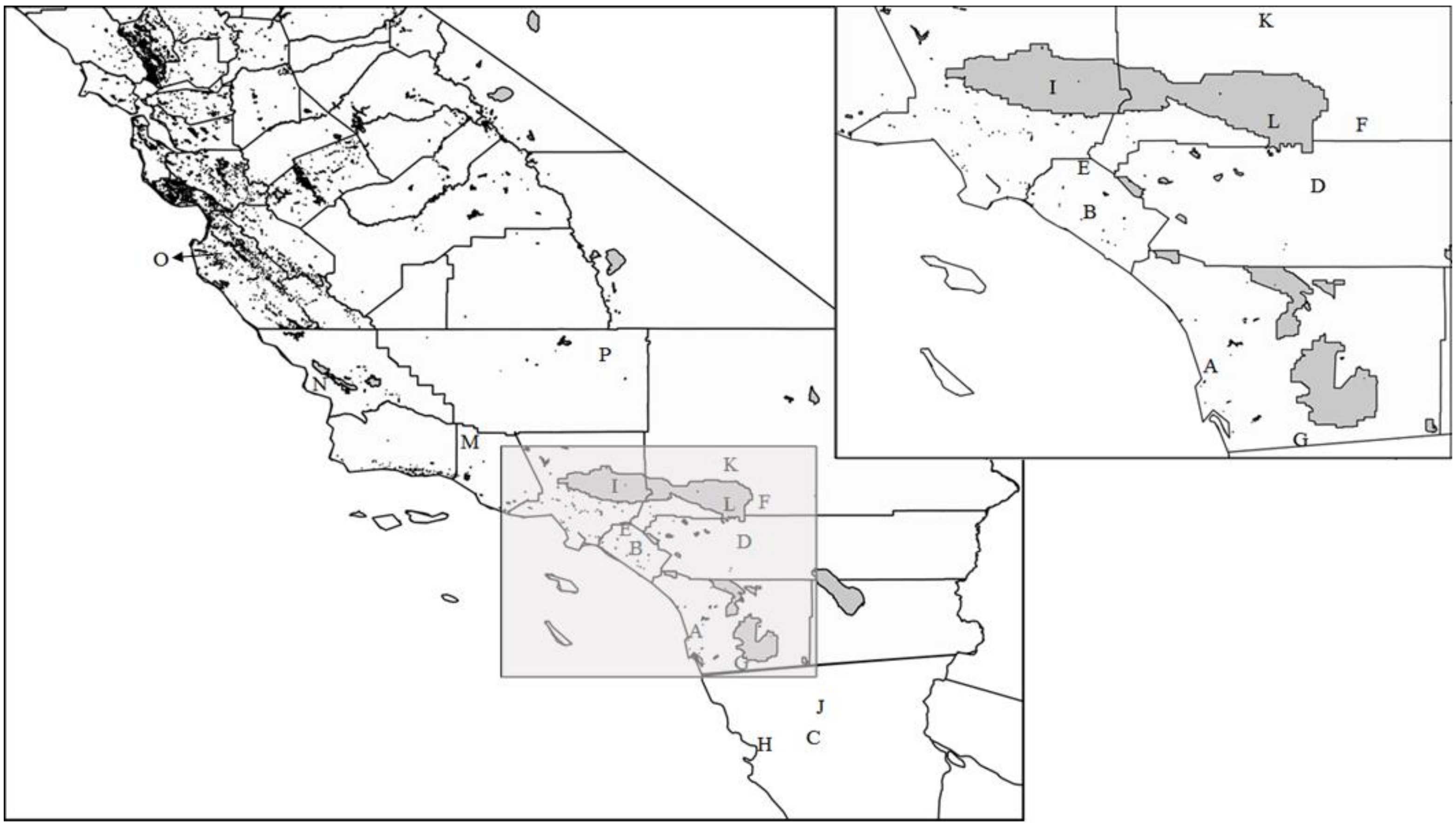


Figure 3. All populations used in the preliminary Discriminant Function Analysis conducted on *A. p. pococki* and *A. p. bajae* combined. Black lines are county, state, and national borders. Dark gray shaded areas are mountain ranges or bodies of water. Inset light gray shaded box is expanded to the right.

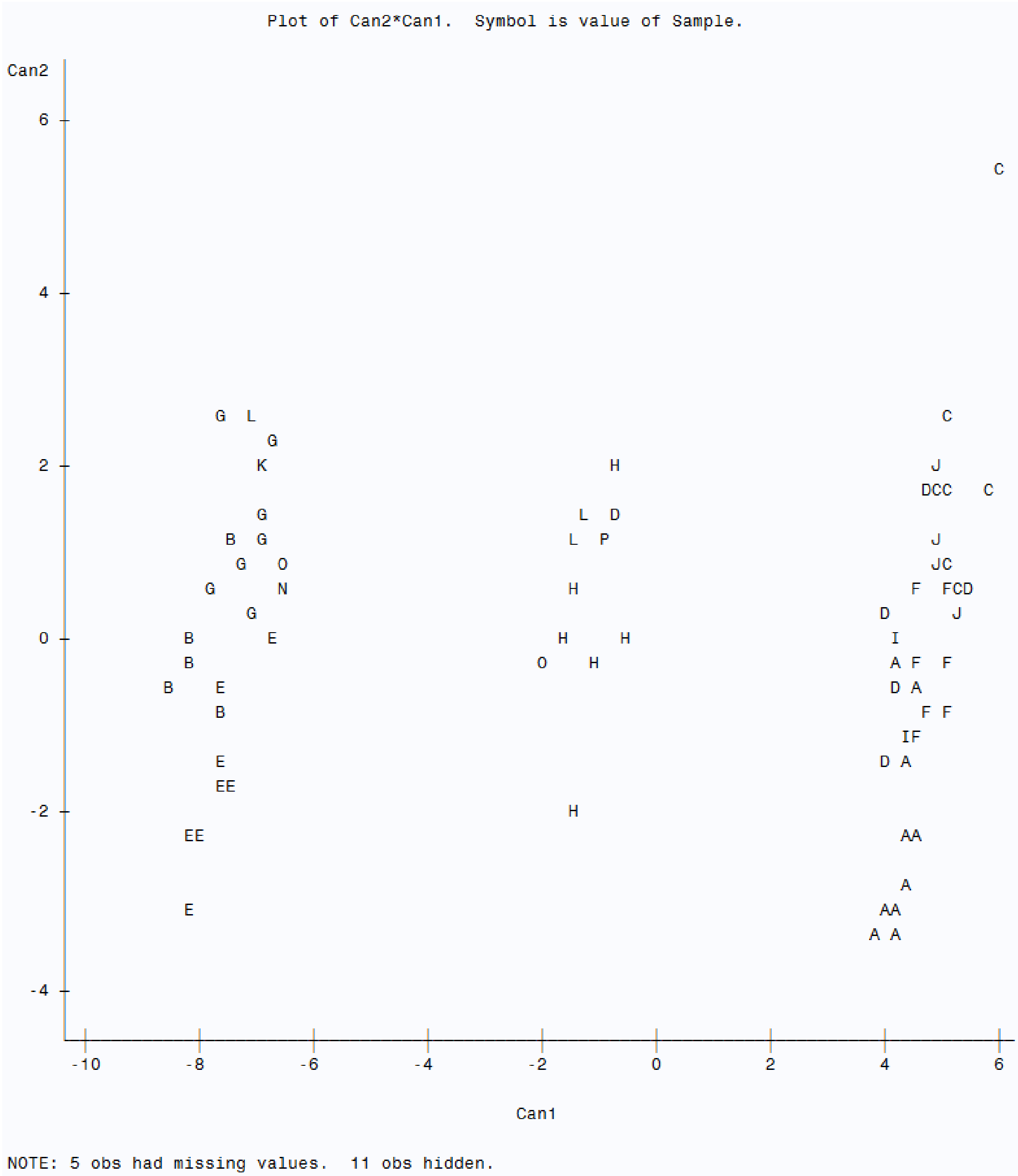


Figure 4. Discriminant Function Analysis of all populations of A. p. pococki and A. p. bajae with the inclusion of coding for infuscation on the digital carina. All other variables are morphometric ratios. See Figure 3 for map of populations.

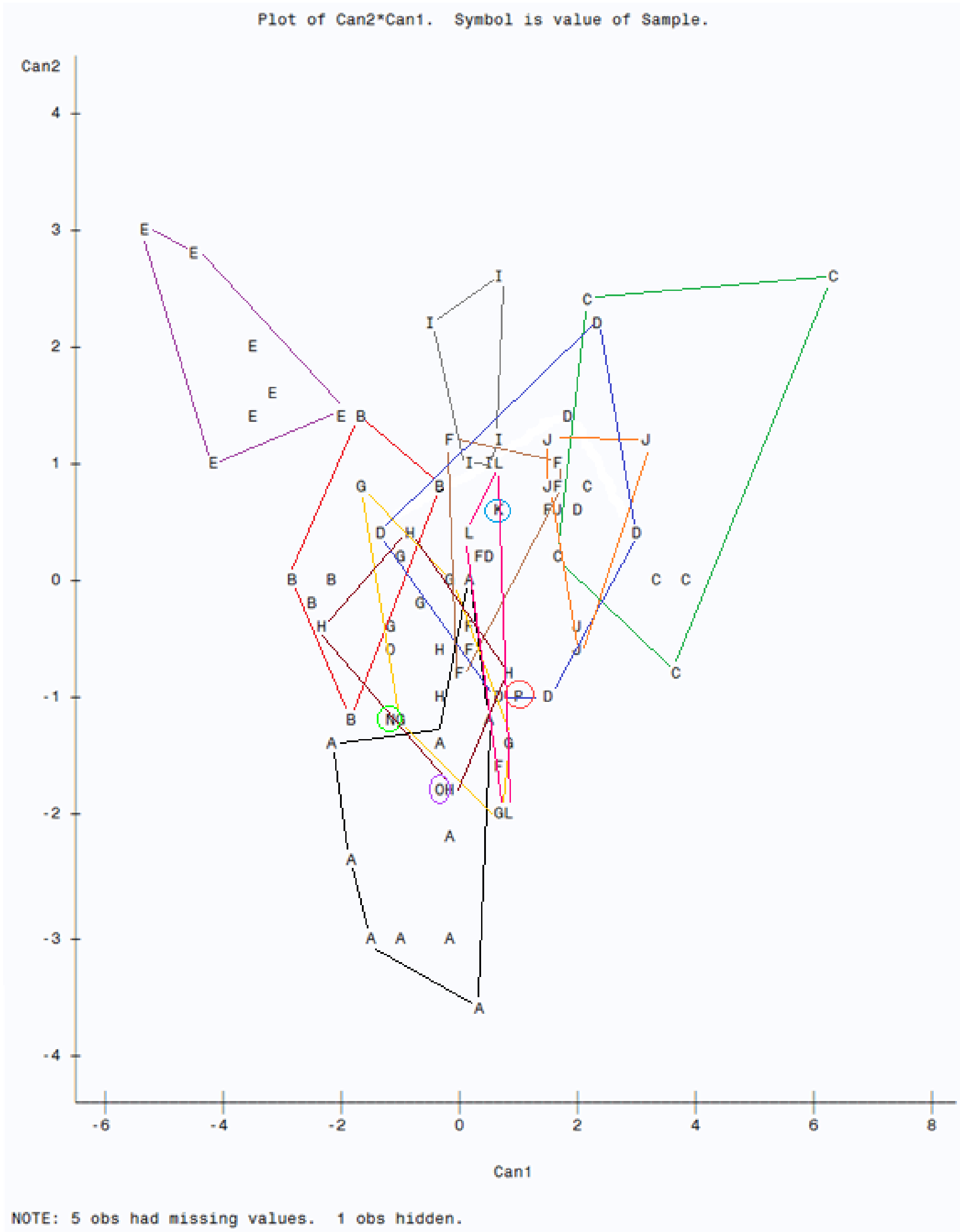


Figure 5. Discriminant Function Analysis on all populations of *A. p. pococki* and *A. p. bajae* without coding the character for digital carina infuscation. All variables are morphometric ratios. See Figure 3 for map of populations.

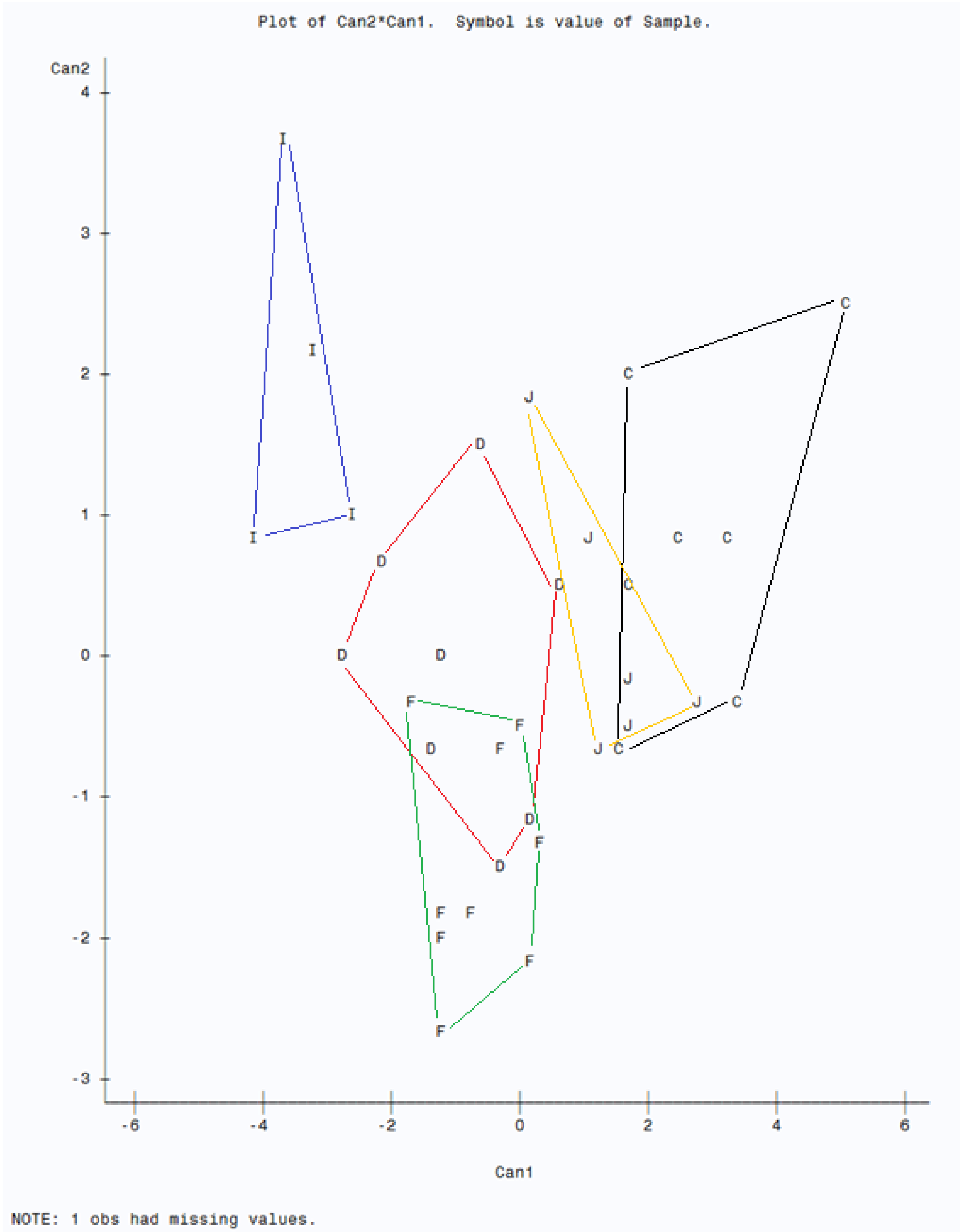


Figure 6. Discriminant Function Analysis of all populations containing scorpions with digital carinae ranging from unpigmented to lightly infuscate (a character of *A. p. bajae*). See Figure 3 for map of populations.

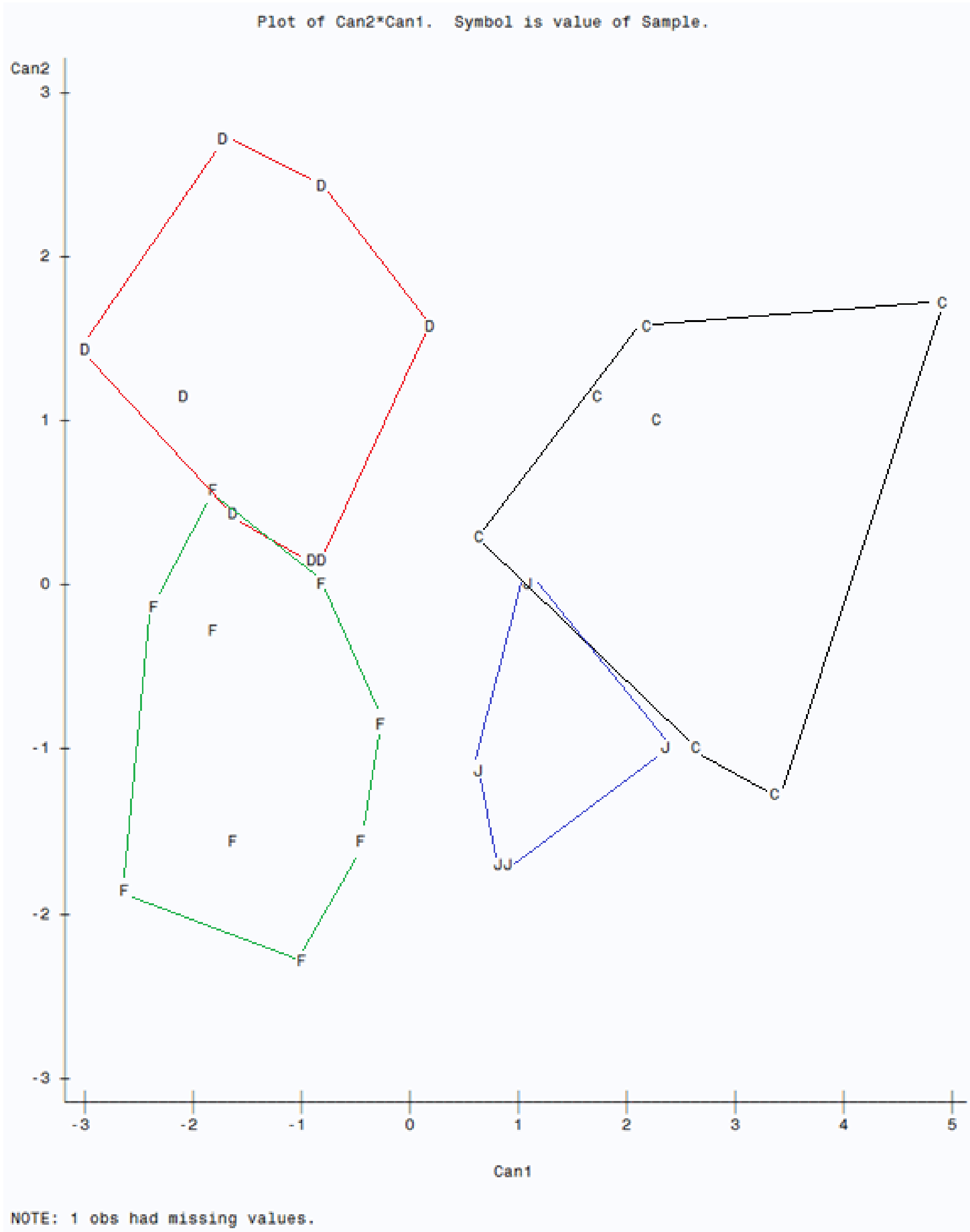


Figure 7. Discriminant Function Analysis of all populations with digital carina that range from unpigmented to lightly infuscate (a character of *A. p. bajae*) utilizing morphometric ratios. Population I was removed after questions about its preservation affected the color analysis. See Figure 3 for map of populations.

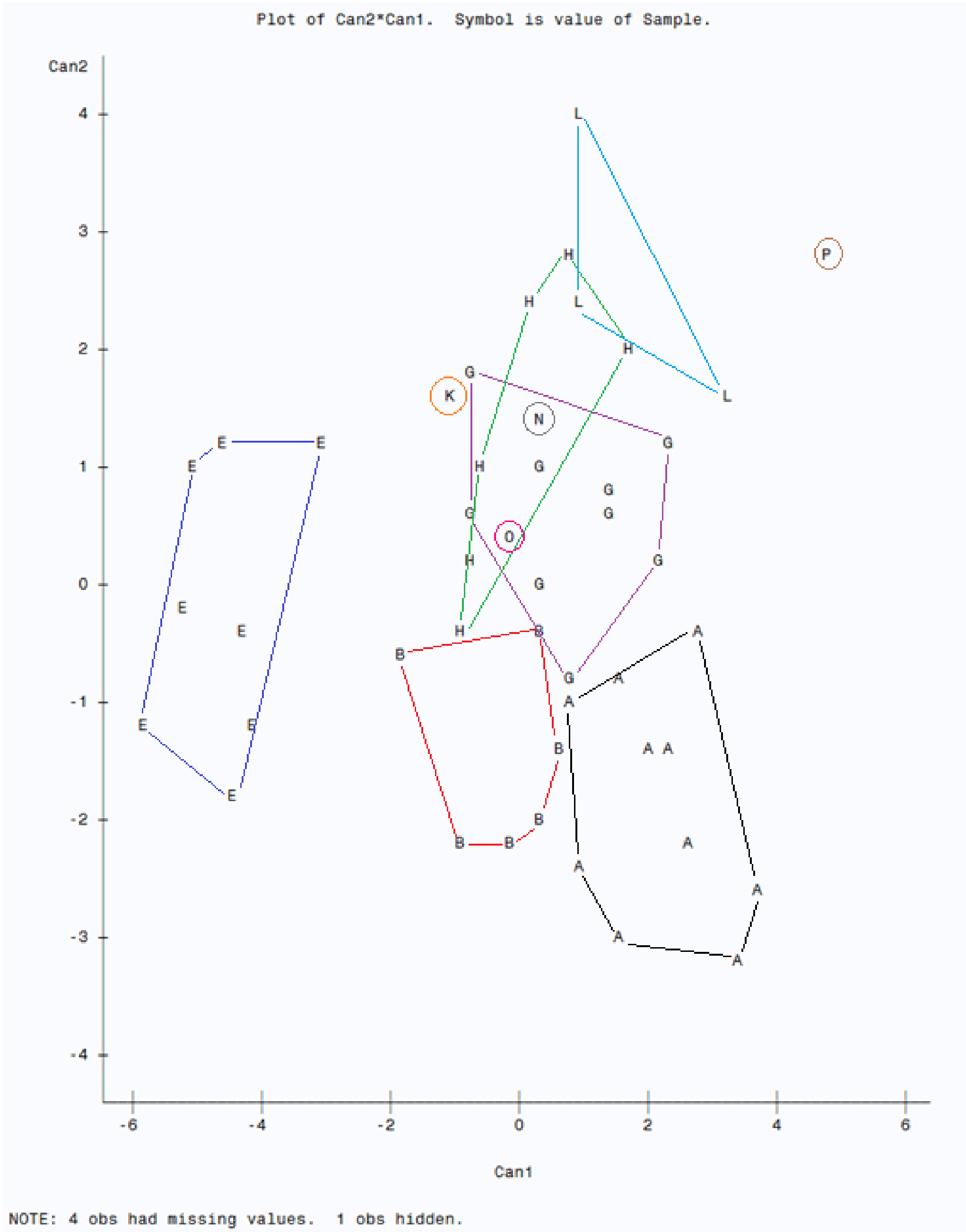


Figure 8. Discriminant Function Analysis of all populations that have scorpions with moderately to heavily infuscate digital carinae (a character of *A. p. pococki*) utilizing morphometric ratios. See Figure 3 for map of populations.

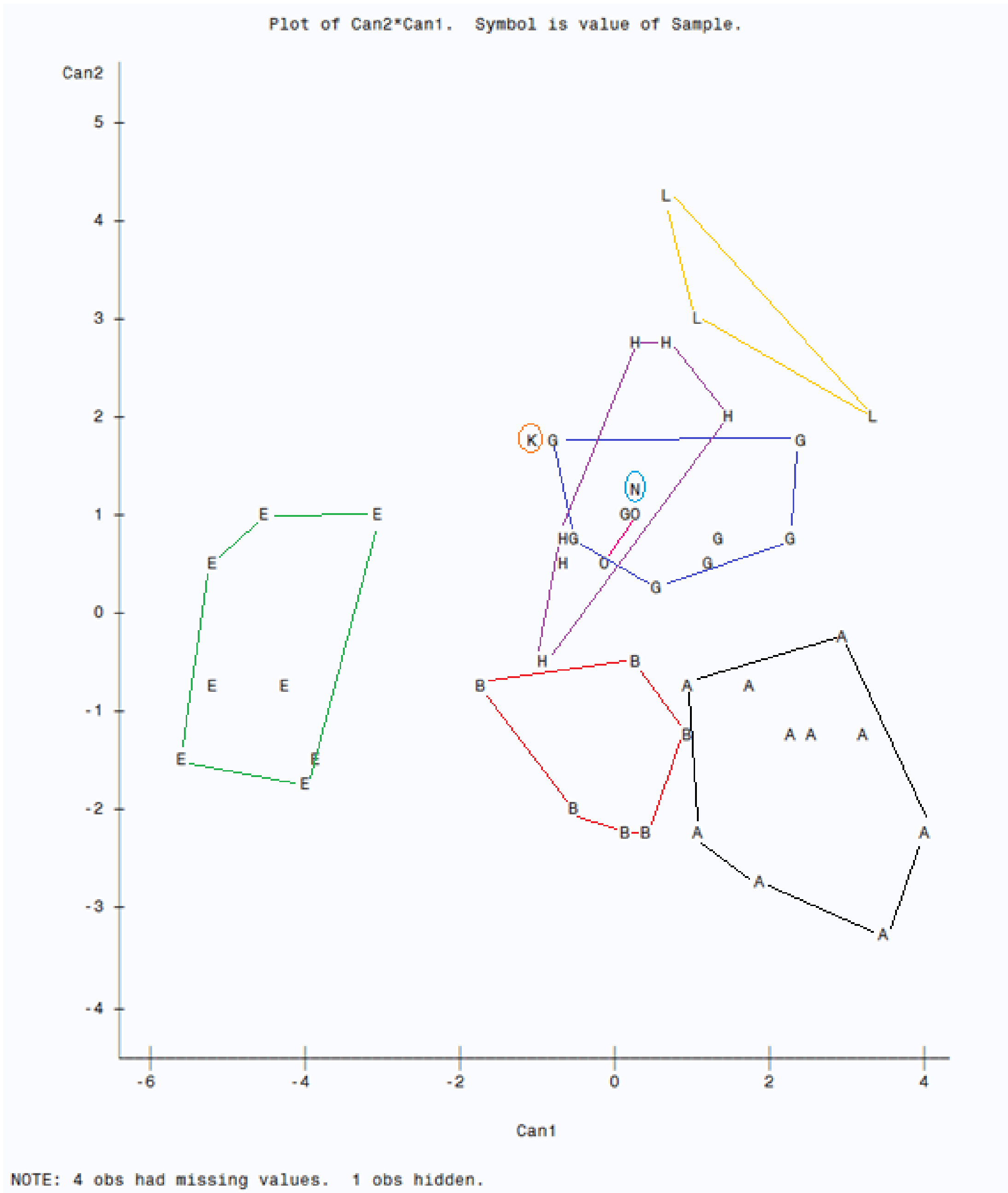


Figure 9. Discriminant Function Analysis of populations with scorpions that have digital carinae ranging from moderately to heavily infuscate (a character of *A. p. pococki*), sans problem population P. Population P was removed after reevaluation determined it was *A. phaiodactylus*. Variables were morphometric ratios. See Figure 3 for map of populations.

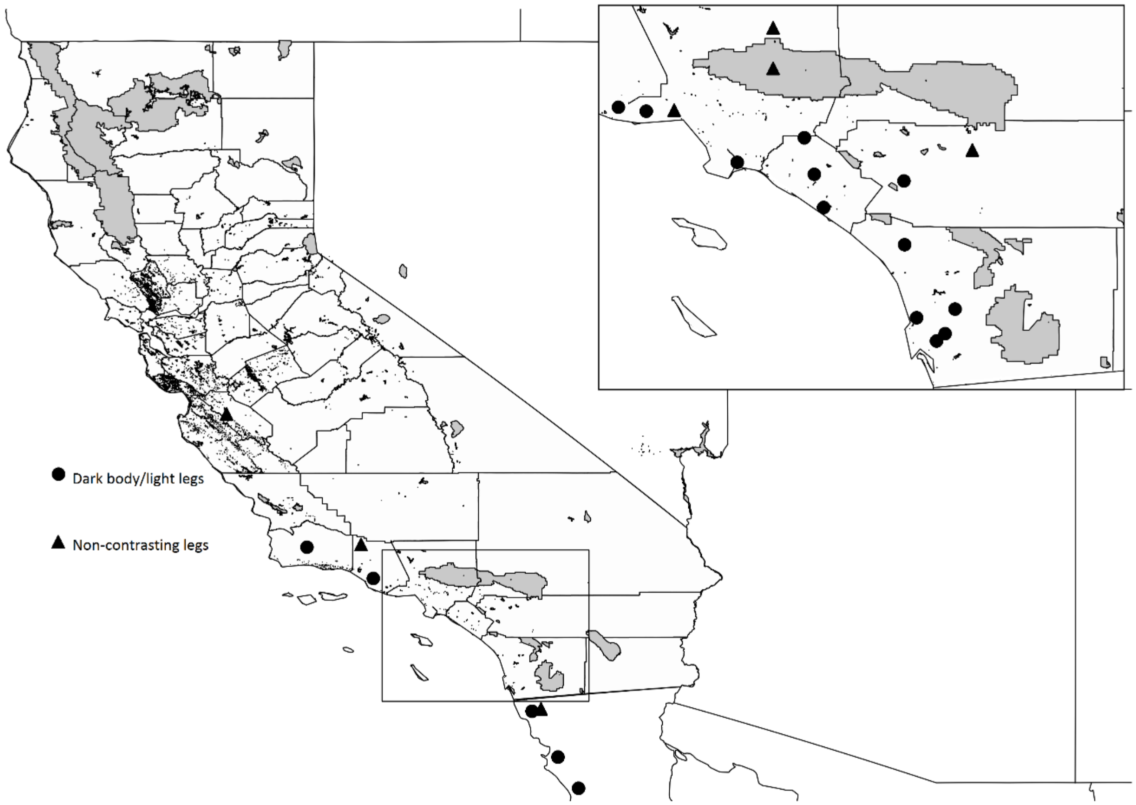


Figure 10. Leg color contrast to body color in males of A. p. pococki for examination of geographic variation. Most coastal populations have contrasting legs whereas inland populations could have both contrasting and non-contrasting legs. Black lines are county, state, and national borders. Dark grey patches are mountain ranges or bodies of water. Inset grey shaded box is expanded to the right.

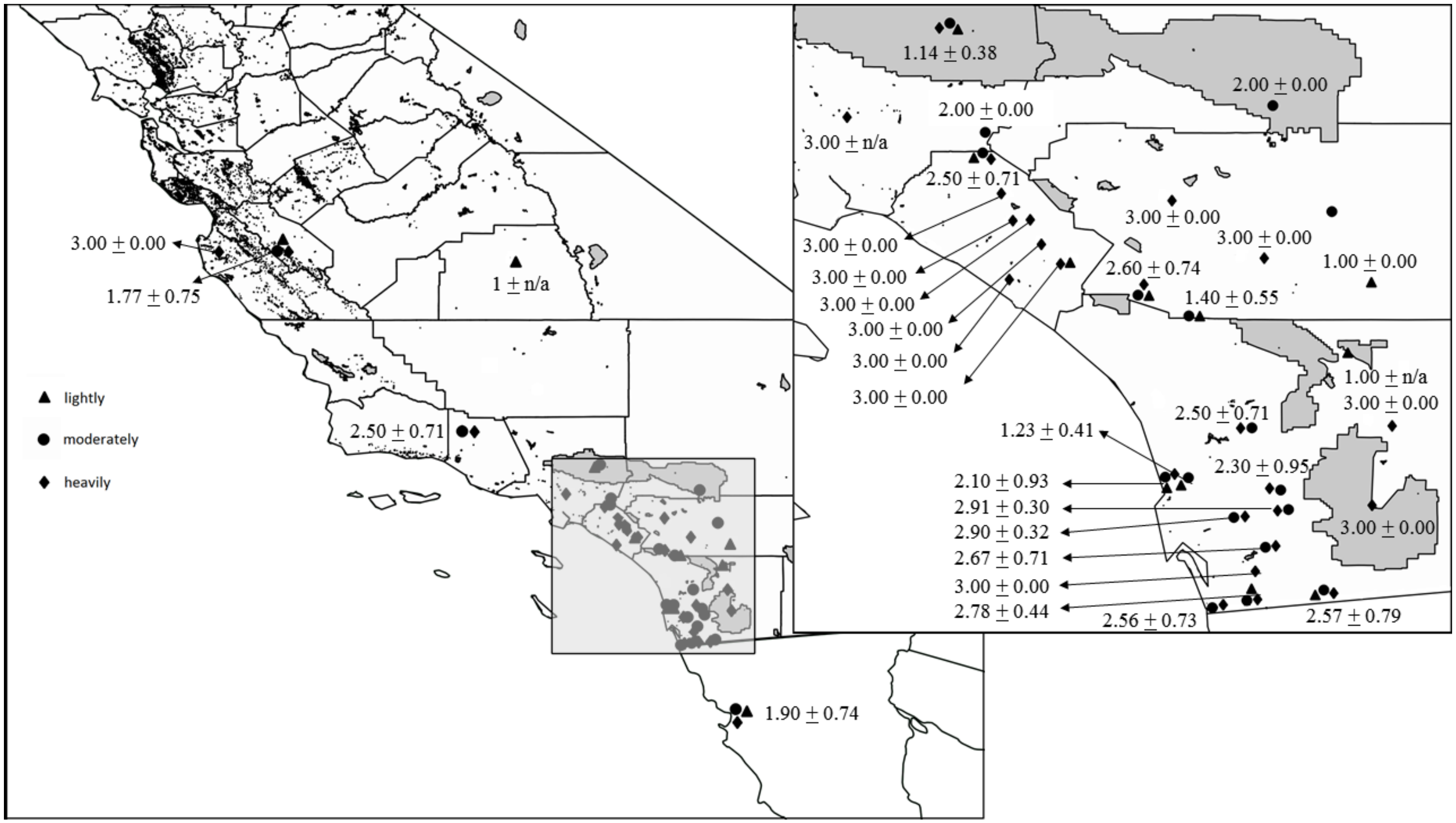


Figure 11. Geographic pattern of digital carina infuscation in males of *A. p. pococki*. Populations were coded for degree of infuscation: (0) unpigmented, (1) lightly, (2) moderately, (3) heavily. Means **±** standard deviations were calculated to examine for diagnosability and geographic variation. Dark grey patches are mountain ranges or bodies of water. Inset gray shaded box is expanded to the right. No standard deviation was reported as “n/a”.

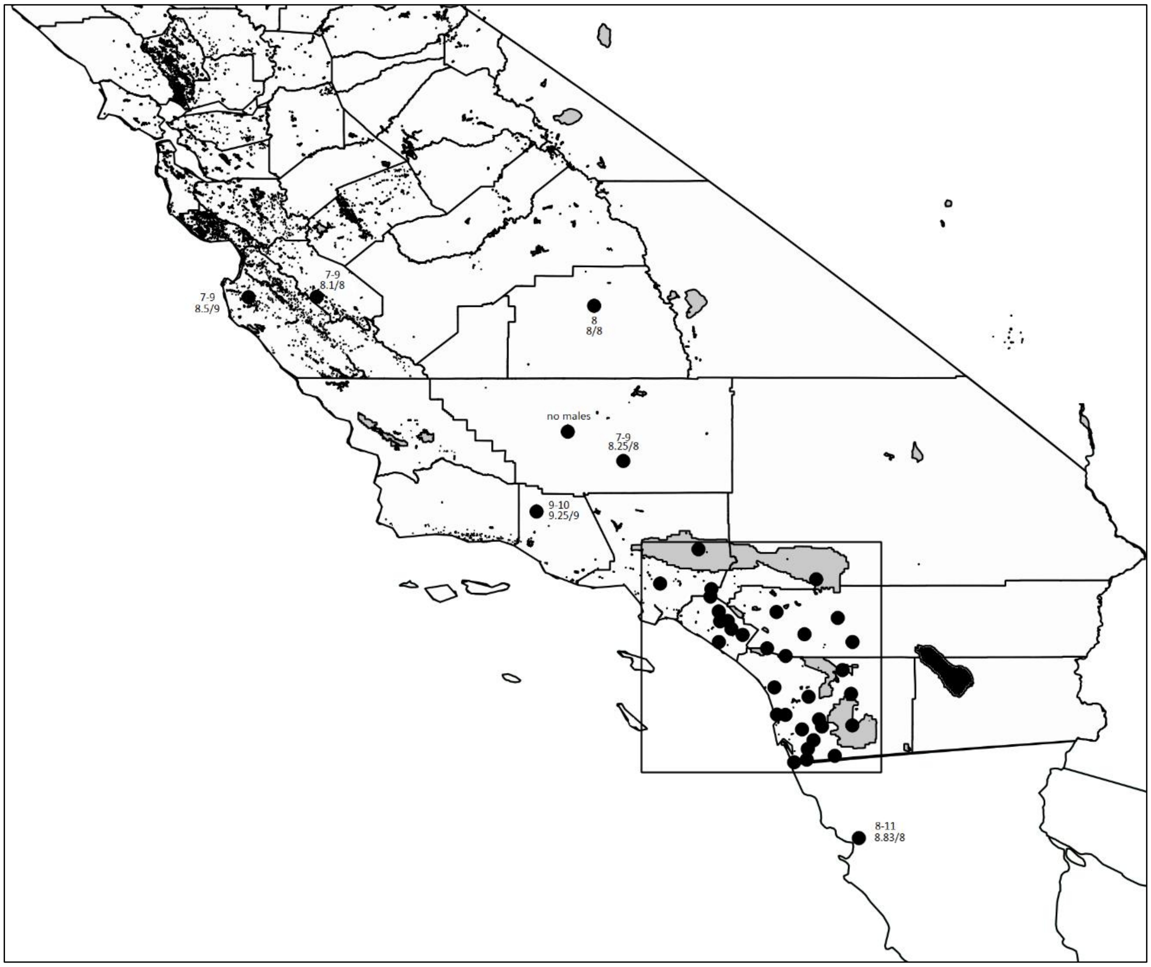


Figure 12. Pectinal tooth counts in A. p. pococki males. Reported as range and below it mean/mode. Black lines are county, state, and national borders. Dark grey patches are mountain ranges. Inset box is expanded in next figure.

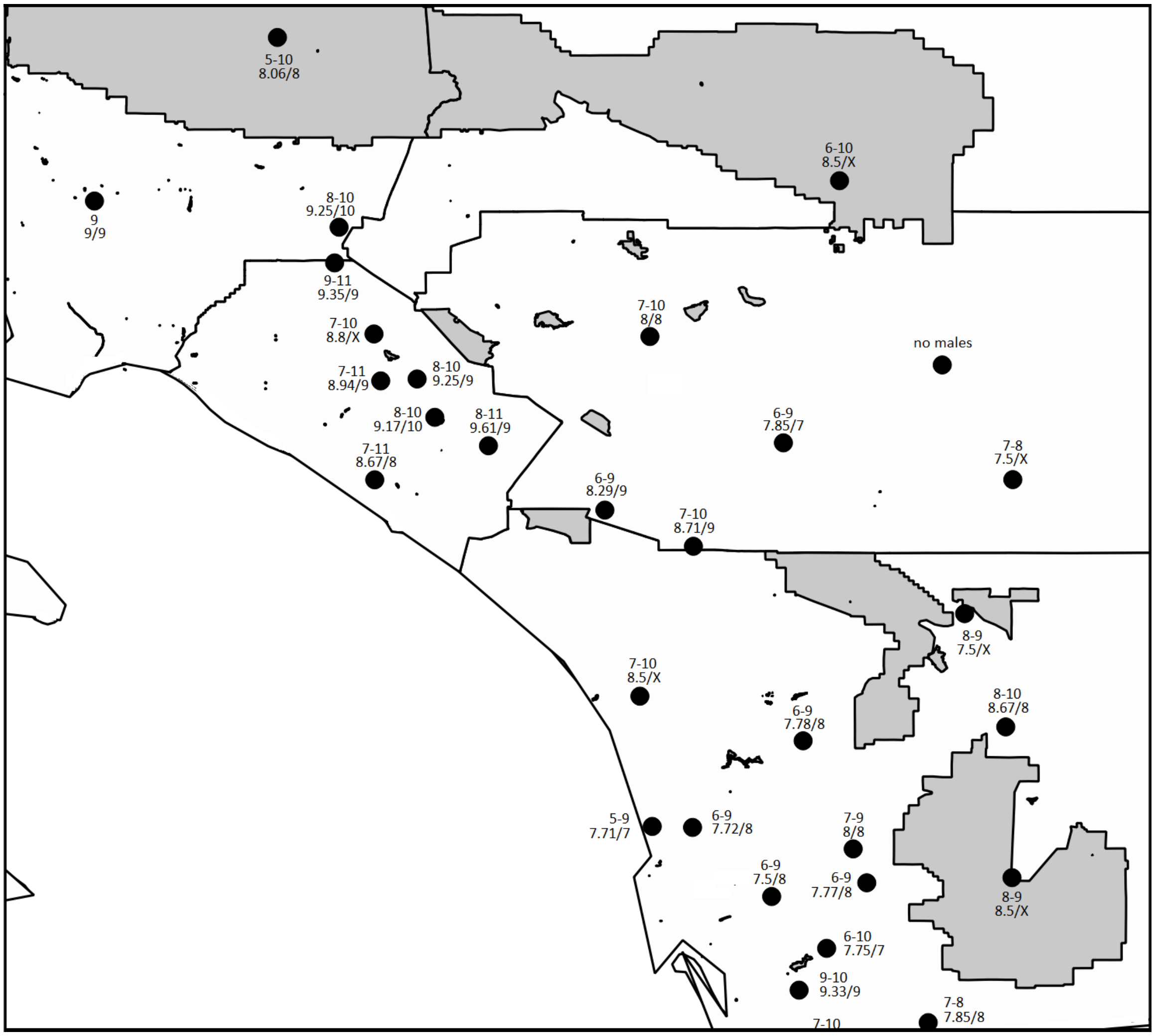


Figure 13. Pectinal tooth counts in *A. p. pococki* males. Reported as range and below it mean/mode in southern California (expanded). Legend in Figure 12.

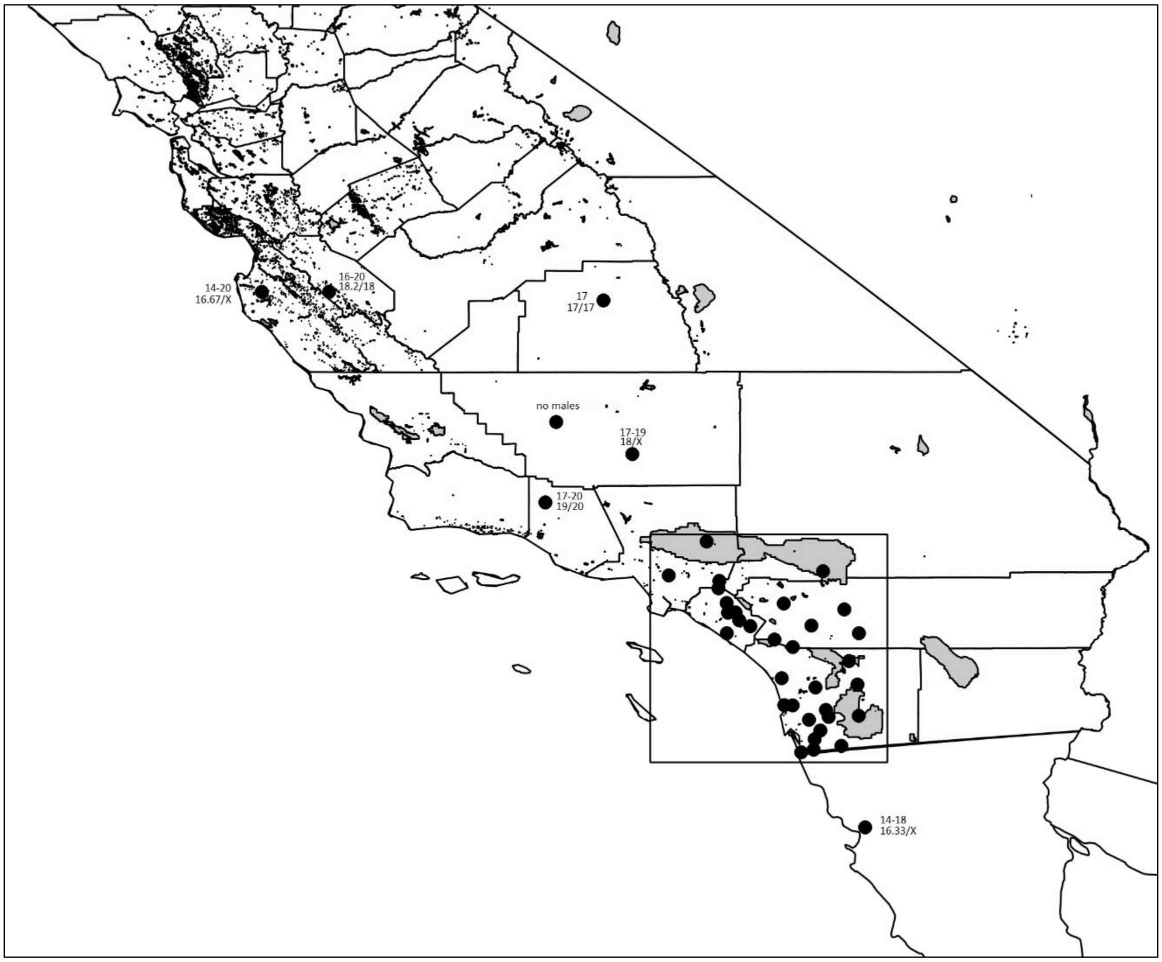


Figure 14. Geographic correlation of trichobothria on the ventroexternal carina on the pedipalp chela in *A. p. pococki*. Reported as range and below it mean/mode. Black lines are county, state, and national borders. Dark grey patches are mountain ranges. Inset box is expanded in next figure.

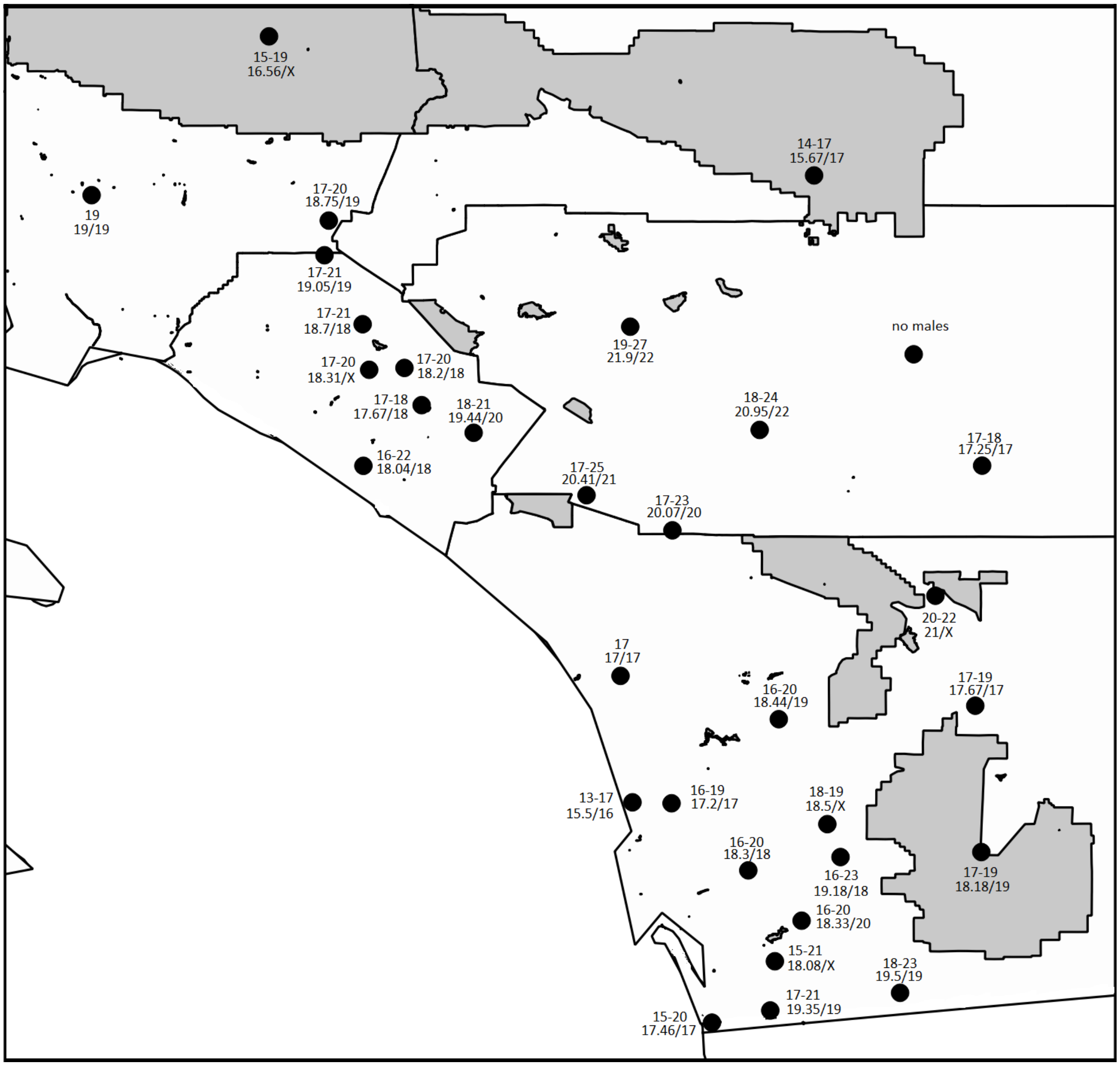


Figure 15. Geographic correlation of trichobothria on the ventroexternal carina on the pedipalp chela in *A. p. pococki* in southern California (expanded). Reported as range and below it mean/mode. Legend in Figure 14.

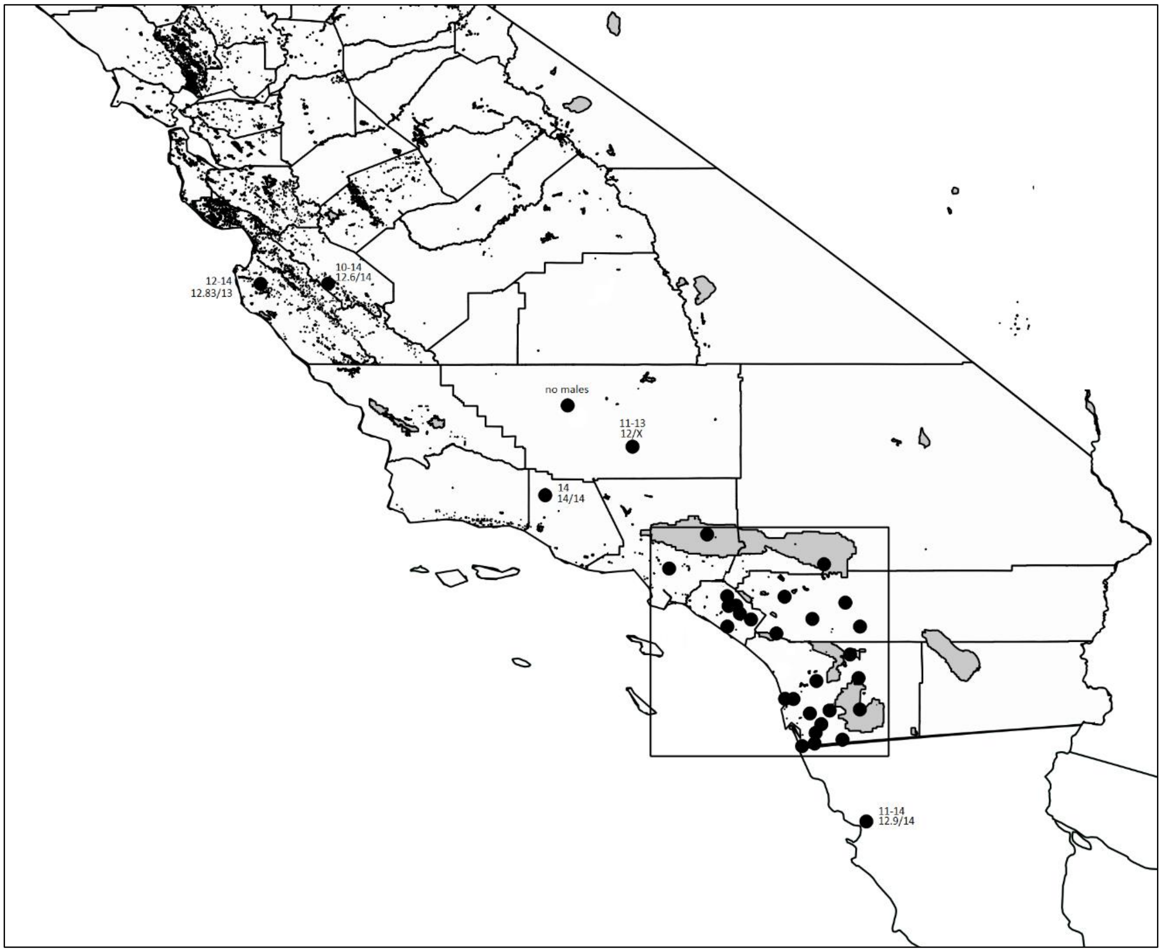


Figure 16. Trichobothria on the ventroexternal carina of the pedipalp patella in *A. p. pococki*. Reported as range and below it mean/mode. Black lines are county, state, and national borders. Dark grey patches are mountain ranges. Inset box is expanded in next figure.

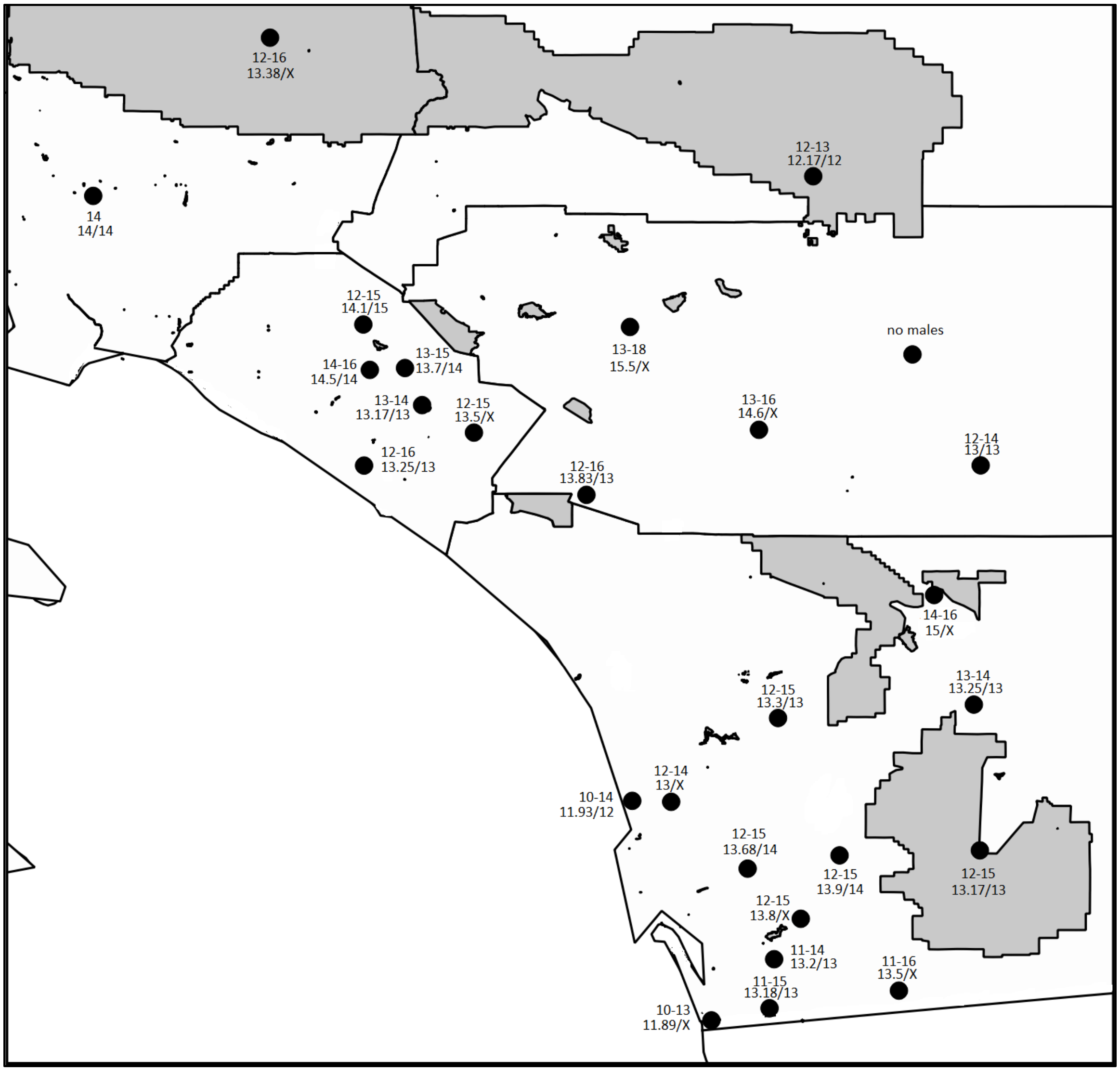


Figure 17. Trichobothria on the ventroexternal carina of the pedipalp patella in *A. p. pococki* in southern California (expanded). Reported as range and below it mean/mode. Legend is in Figure 16.

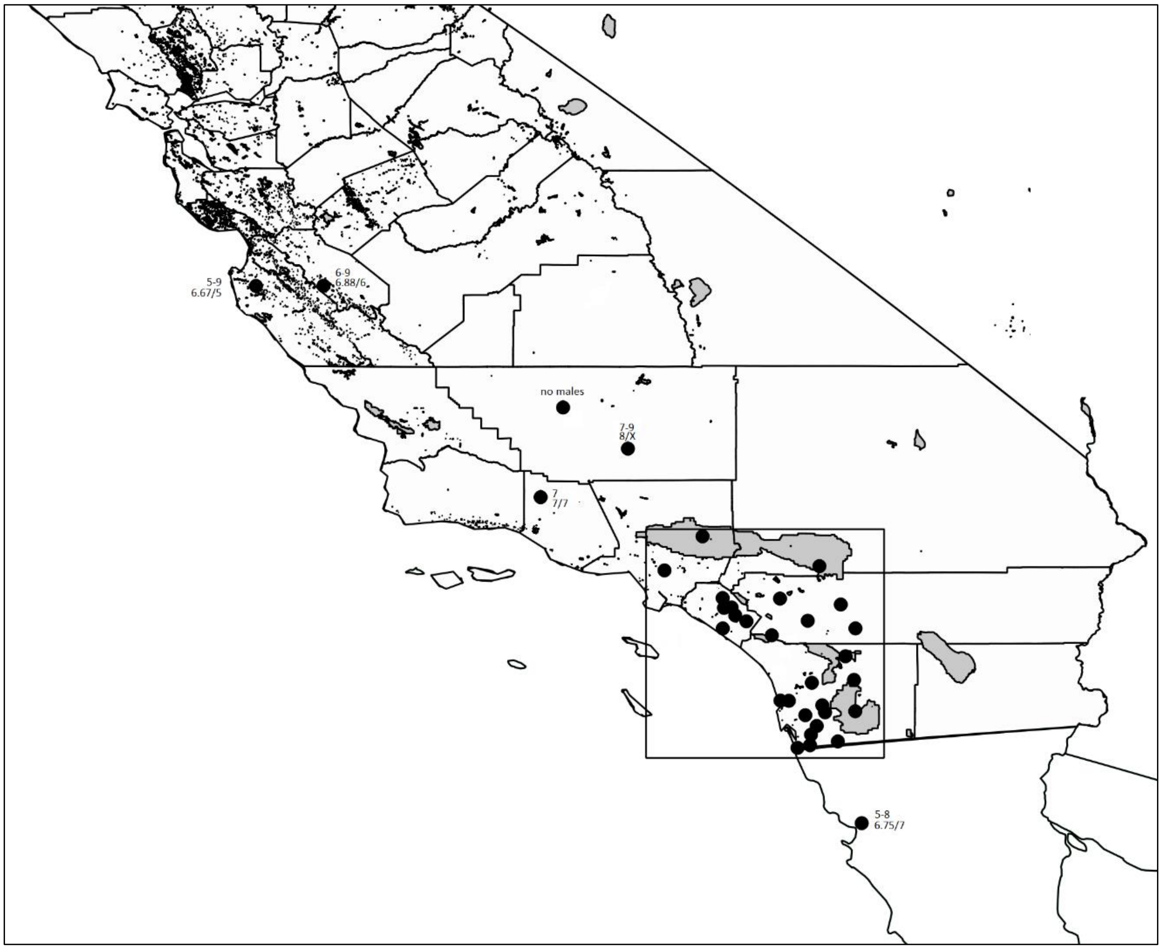


Figure 18. Trichobothria in the wrap around arc on the dorsal face of the pedipalp patella in *A. p. pococki*. Reported as range and below it mean/mode. Black lines are county, state, and national borders. Dark grey patches are mountain ranges. Inset box is expanded in next figure.

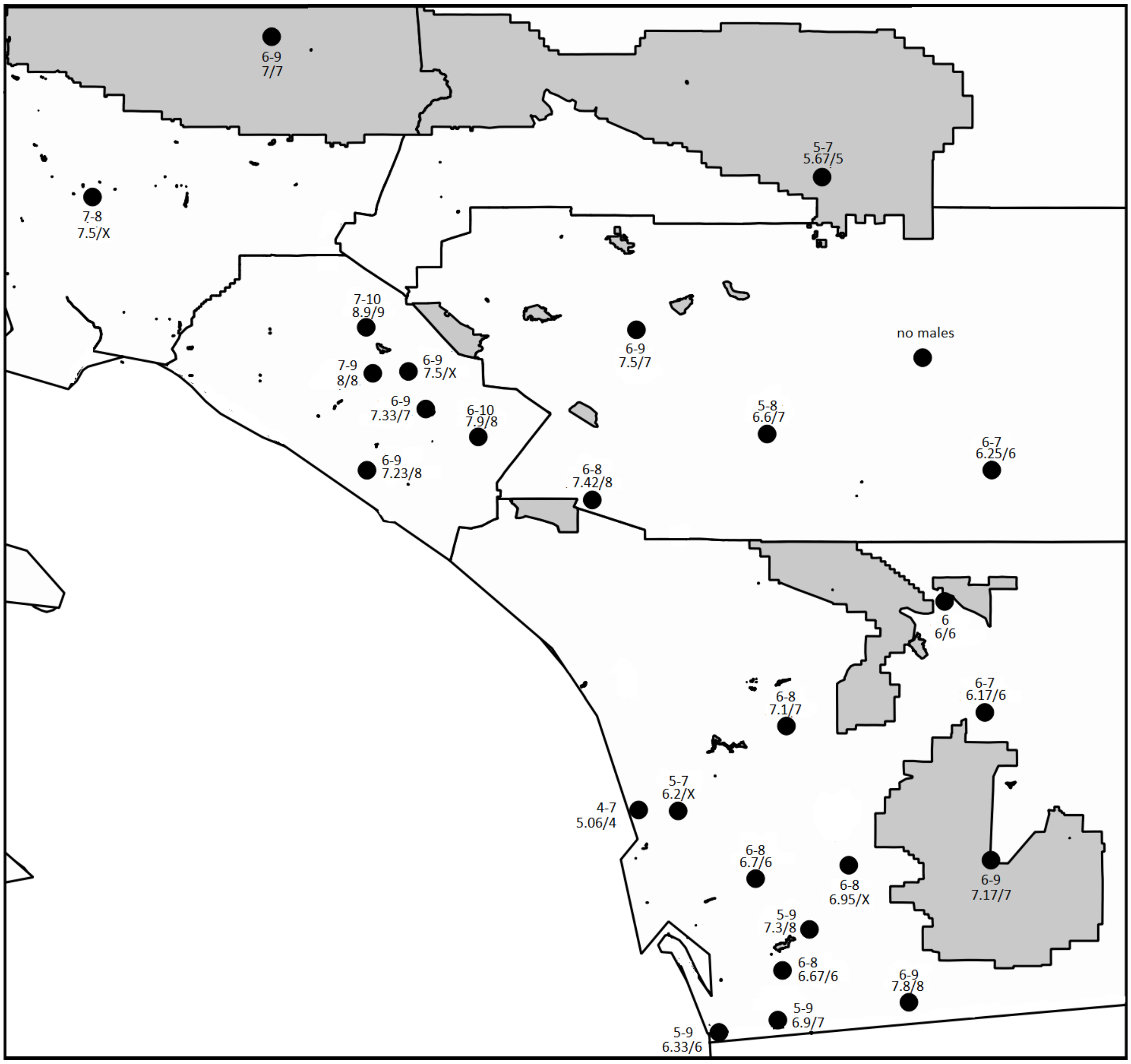


Figure 19. Trichobothria in the wrap around arc on the dorsal face of the pedipalp patella in *A. p. pococki* in southern California (expanded). Reported as range and below it mean/mode. Legend is in Figure 18.

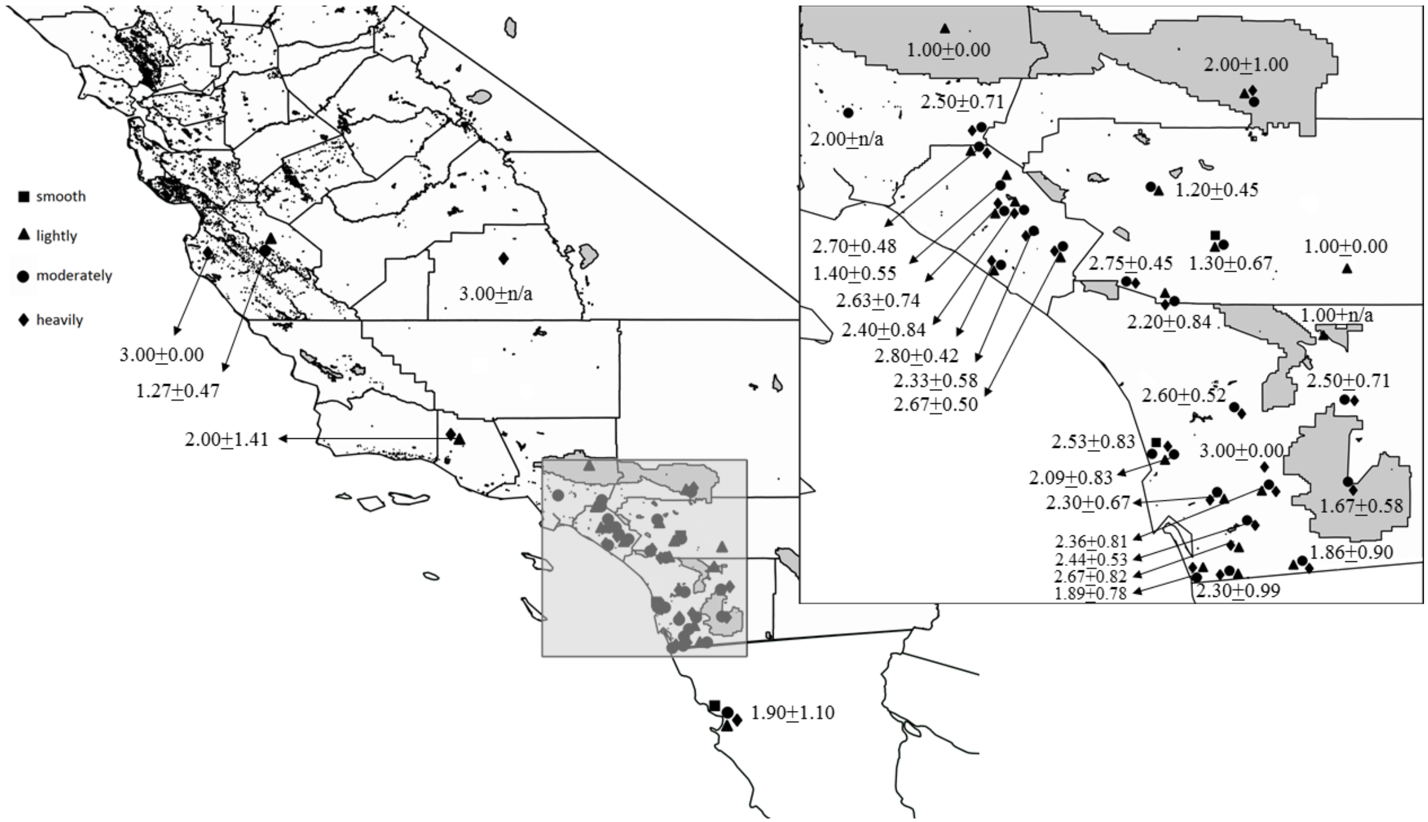


Figure 20. Geographic variation in interocular granulation of A. p. pococki males. Granulation was evaluated as being: (0) smooth, (1) lightly, (2) moderately, and (3) heavily granulated. Means and standard deviation were calculated for each population. Black lines are county, state, and national borders. Dark grey patches are mountain ranges or bodies of water. Light grey shaded box is expanded to right.

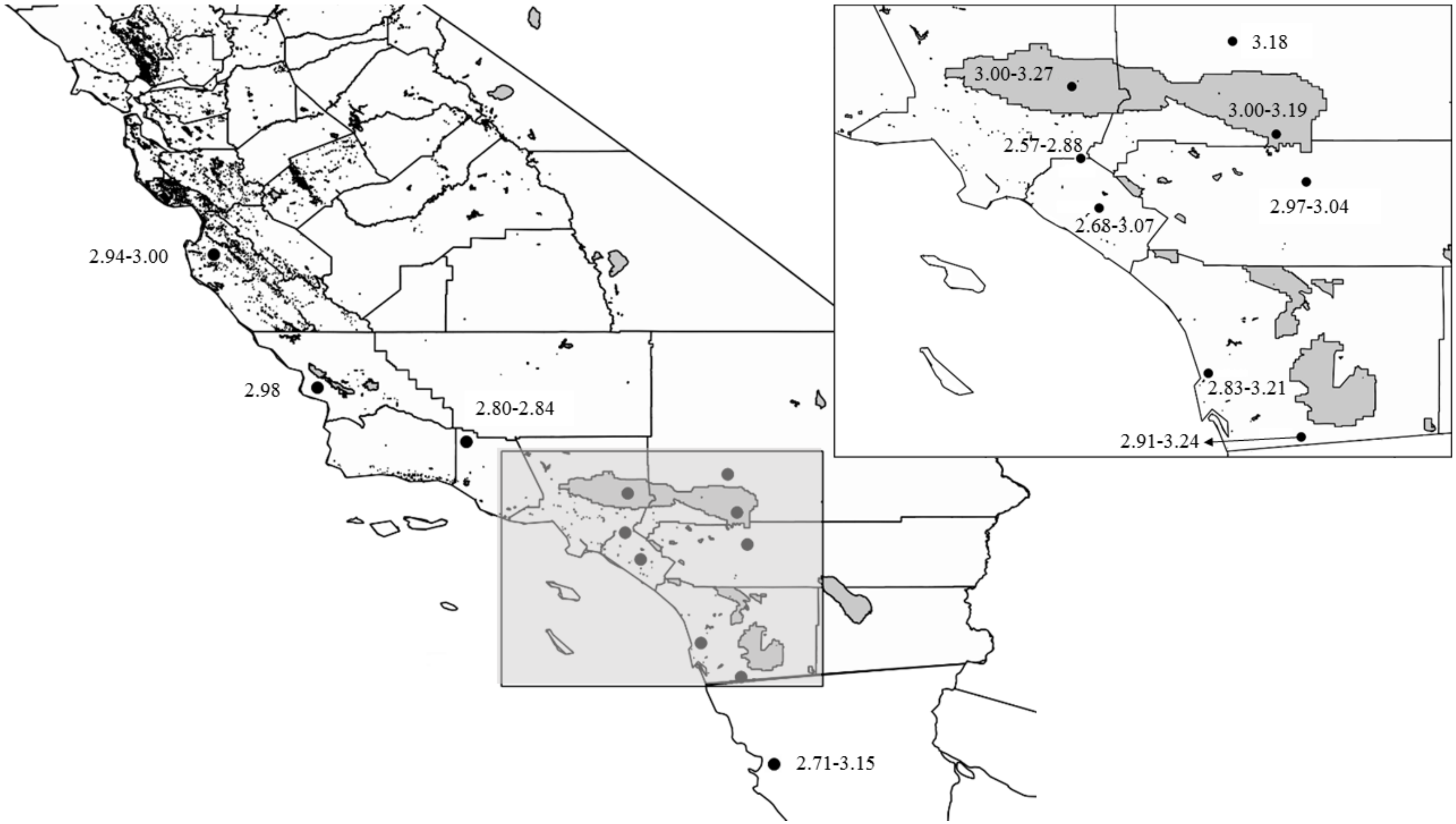


Figure 21. Geographic variation of the measurement ratio pedipalp chela length/pedipalp chela width in *A. p. pococki* males. Black lines are county, state, and national borders. Dark grey patches are mountain ranges or bodies of water. Light grey shade box is expanded to the right.


Figure 22. Size variation in *A. p. pococki* males. Top: Del Mar Mesa, CA. Bottom: Chino Hills, CA.


Figure 23. *Anuroctonus* male from population PIN in the Pinnacles National Monument.


Figure 24. *Anuroctonus* male from population SGM in Bear Valley.


Figure 25. Left: *Anuroctous phaiodactylus* habitus photos. Top Row: Male from Walker Pass, CA. Bottom Row: Female from Walker Pass, CA.

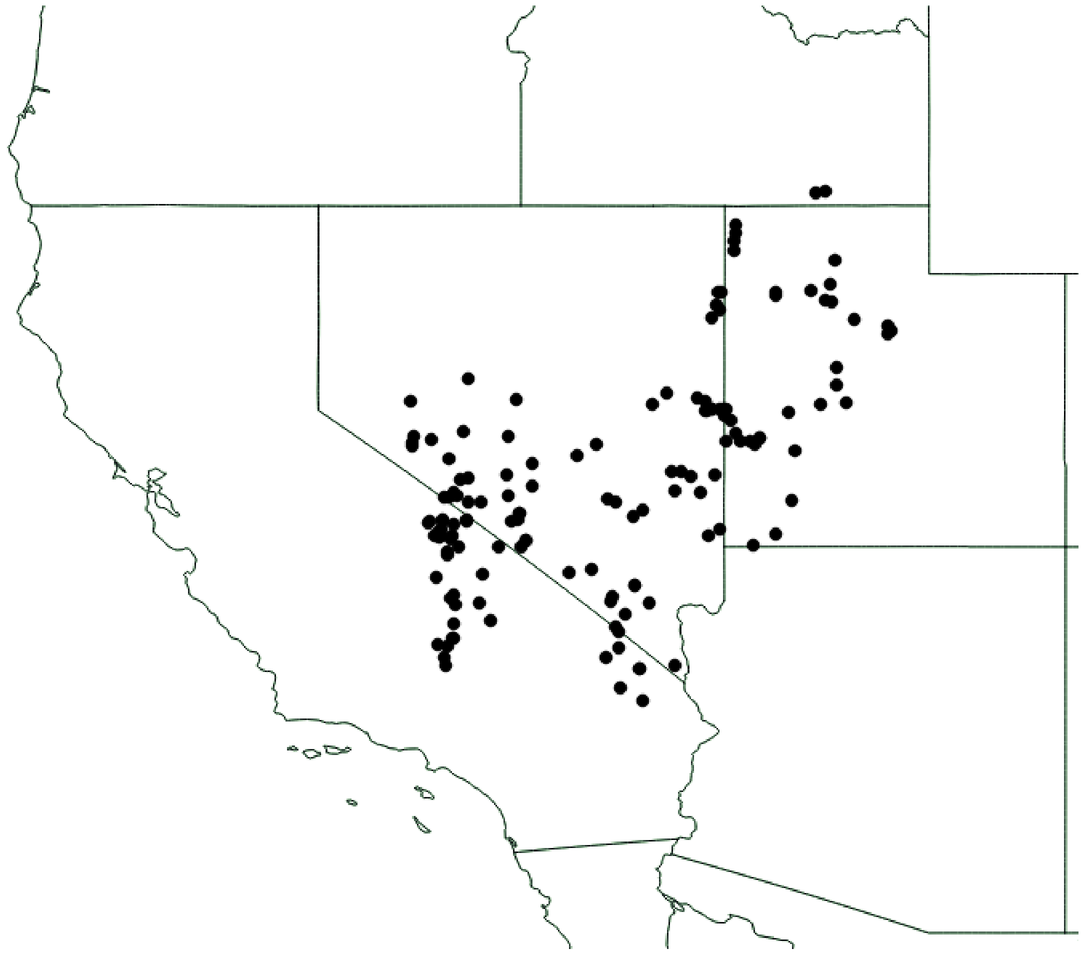

Figure 26. Distribution of *Anuroctonus phaiodactylus* in western Utah, southern Idaho, Nevada, and eastern California.


Figure 27. *Anuroctonus bajae* habitus photos. Top Row: Paratopotype, Male from Ojos Negros, Baja California Norte. Bottom Row: Paratopotype, Female from Ojos Negros, Baja California.


Figure 28. Variation in *A. bajae* males. Top: Covington Flats, CA. Bottom: Paratopotype, Ojos Negros, Baja California.

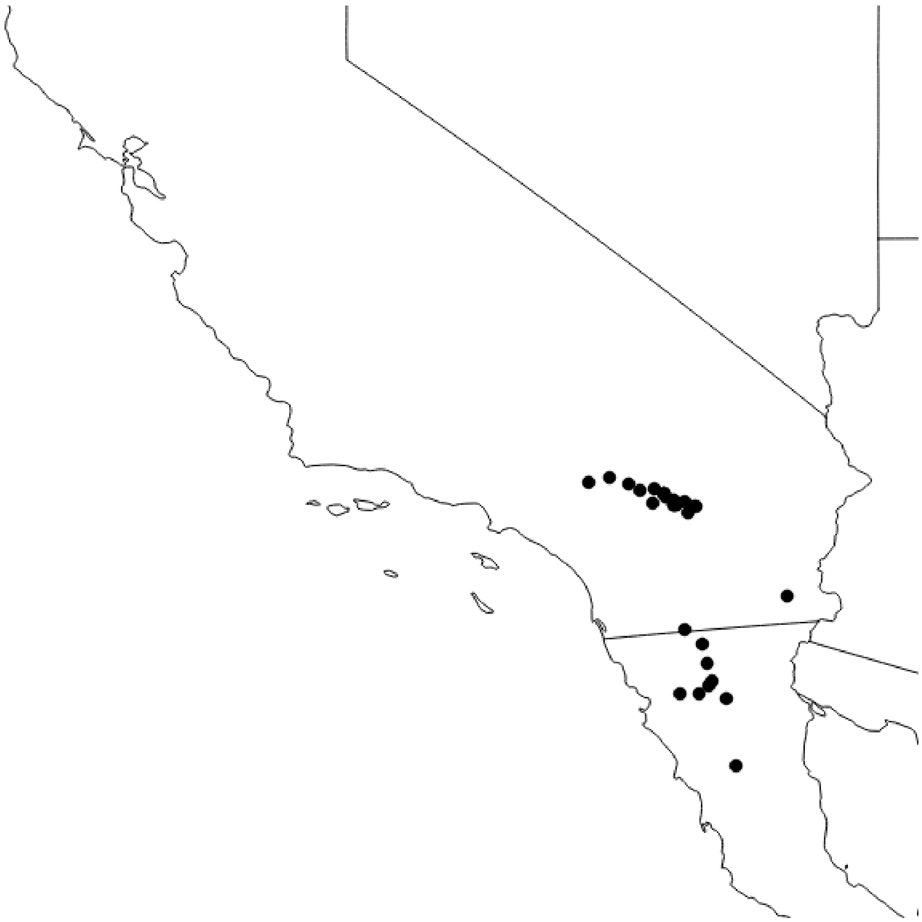

Figure 29. *Anuroctonus bajae* distribution in southern California, USA and Baja California, Mexico.


Figure 30. *Anuroctonus pococki* habitus photos. Top Row: Male from Chino Hills, CA. Bottom Row: Female from Rattlesnake Reservoir, CA.

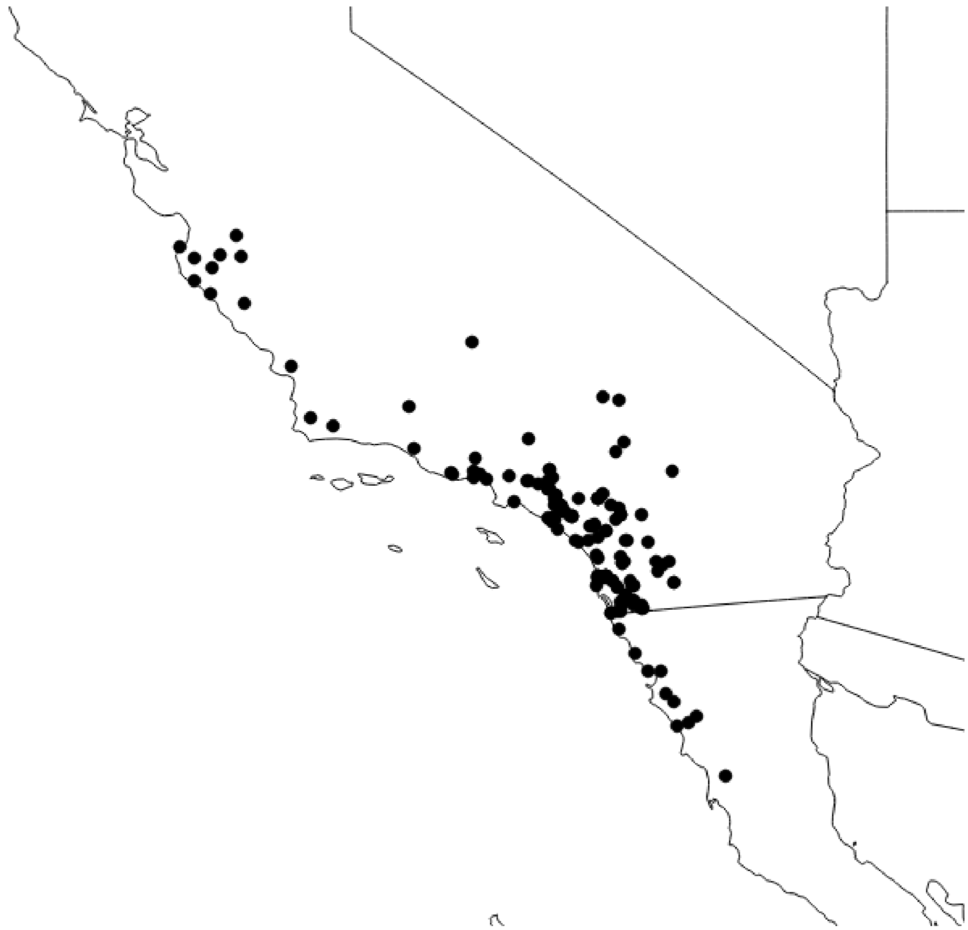

Figure 31. Distribution of *Anuroctonus pococki* in southern California, USA and Baja California, Mexico.