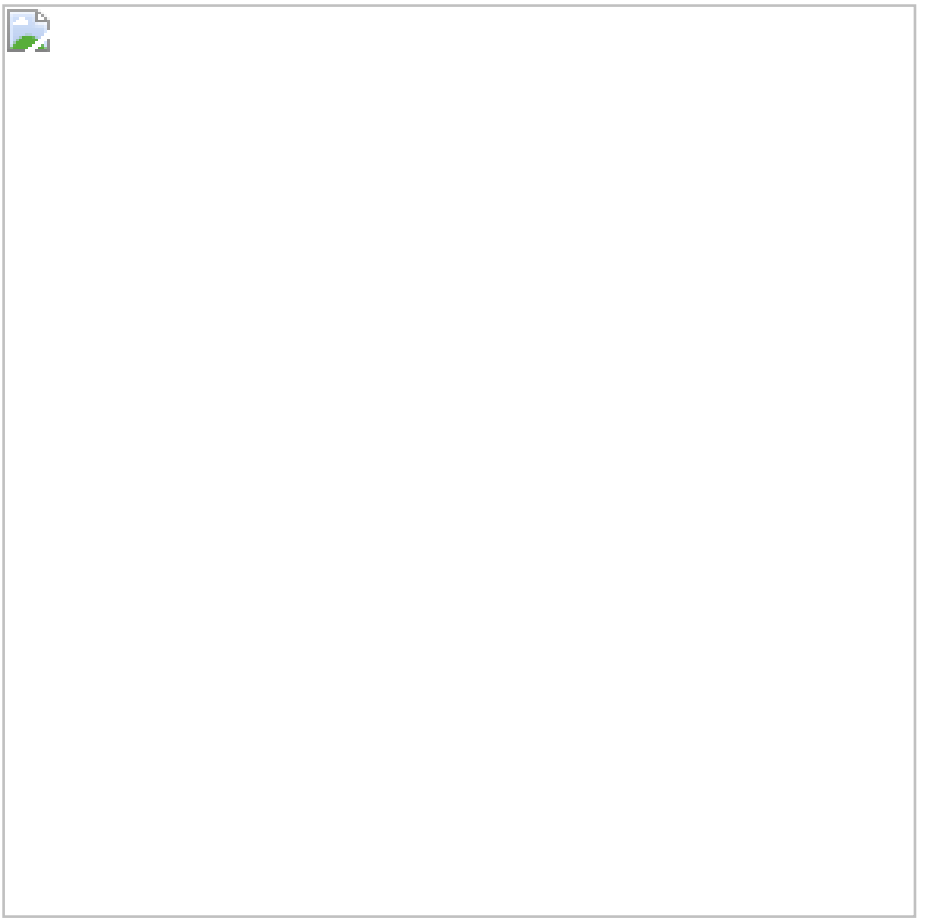

The vorhiesi Group of Vaejovis C.L. Koch, 1836 (Scorpiones: Vaejovidae), in Arizona, with Description of a New Species from the Hualapai Mountains

Authors: Sissom, W. David, Hughes, Garrett B., Bryson, Robert W., and Prendini, Lorenzo

Source: American Museum Novitates, 2012(3742) : 1-19

Published By: American Museum of Natural History

URL: https://doi.org/10.1206/3742.2

AMERICAN MUSEUM NOVITATES

Number 3742, 19 pp. May 3, 2012

The *vorhiesi* group of *Vaejovis* C.L. Koch, 1836 (Scorpiones: Vaejovidae), in Arizona, with description of a new species from the Hualapai Mountains

W. DAVID SISSOM,[1] GARRETT B. HUGHES,[2] ROBERT W. BRYSON, JR.,[3] AND LORENZO PRENDINI[4]

ABSTRACT

A new species in the *vorhiesi* group of *Vaejovis* C.L. Koch, 1836 (Vaejovidae Thorell, 1876), which appears to be endemic to the Hualapai Mountains near Kingman, Arizona, is described and illustrated. *Vaejovis tenuipalpus*, n. sp., the 11th species in the *vorhiesi* group, is compared to morphologically similar species, including *V. jonesi* Stahnke, 1940, *V. lapidicola* Stahnke, 1940, *V. vorhiesi* Stahnke, 1940, and *V. deboerae* Ayrey, 2009. The new species possesses the most slender pedipalp chelae in the *vorhiesi* group. New distribution records and a comprehensive distribution map are provided for all Arizona members of the group.

KEY WORDS: Scorpiones, Vaejovidae, *Vaejovis*, systematics, Nearctic, Arizona.

[1]Department of Life, Earth, and Environmental Sciences, West Texas A&M University, WTAMU Box 60808, Canyon, TX 79016-0001.

[2]Department of Entomology, University of Arizona, Forbes 410, Tucson, AZ 85721-0036.

[3]Barrick Museum of Natural History, University of Nevada, Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154-4012.

[4]Scorpion Systematics Research Group, Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th St., New York, NY 10024-5192.

 ISSN 0003-0082

INTRODUCTION

The Hualapai Mountains, approximately 19 km southeast of Kingman, Arizona, form a prominent mountain range isolated from other Basin and Range mountains by arid desert plains. Field research in the pine-oak forest of the Hualapai Mountains (fig. 1A) resulted in the collection of a new species of montane vaejovid scorpion belonging to the *vorhiesi* group of *Vaejovis* C.L. Koch, 1836 (fig. 1B). The taxonomic history of this morphologically homogeneous group was reviewed elsewhere (Graham and Bryson, 2010). The new species raises to 11 the number of described species in the group, the others being *Vaejovis bigelowi* Sissom, 2011, *Vaejovis cashi* Graham, 2007, *Vaejovis crumpi* Ayrey and Soleglad, 2011, *Vaejovis deboerae* Ayrey, 2009, *Vaejovis electrum* Hughes, 2011, *Vaejovis feti* Graham, 2007, *Vaejovis jonesi* Stahnke, 1940, *Vaejovis lapidicola* Stahnke, 1940, *Vaejovis paysonensis* Soleglad, 1973, and *Vaejovis vorhiesi* Stahnke, 1940. It is the ninth member of the *vorhiesi* group recorded from Arizona (fig. 2) and the third from the more northern areas of the state, the others being *V. jonesi* and *V. lapidicola*. The aim of the present contribution is to describe this species and compare it to these and others in the group to which it is most similar. In addition, new distribution records and a comprehensive distribution map are provided for all Arizona members of the group.

METHODS

Material is deposited in the following collections: American Museum of Natural History, New York (AMNH); California Academy of Sciences, San Francisco (CAS); Florida State Collection of Arthropods, Gainesville (FSCA); Museum of Northern Arizona, Flagstaff (MNA); Museum of Southwestern Biology, Albuquerque (MSB); United States National Museum (USNM); Joe L. Bigelow private collection (JLB); W. David Sissom private collection (WDS).

Habitus images were taken using a Microptics ML-1000 digital imaging system, under visible light. Illustrations of external morphology were produced from digital images. Hemispermatophores were dissected and studied according to the procedure described in Sissom et al. (1990).

Nomenclature follows Hjelle (1990); mensuration follows Sissom et al. (1990); trichobothrial designations follow Vachon (1974); macrosetal nomenclature and conventions follow Haradon (1984) for the pedipalps, Santibañez and Sissom (2010) for the metasoma, and McWest (2009) for leg III.

Measurements (in mm) were recorded using a Nikon SMZ 1500 stereomicroscope equipped with an ocular micrometer and calibrated at 20×. For comparison, the extent of the lateral inframedian (LIM) carinae on metasomal segments II–IV was calculated as the distance from the posterior edge of the segment to the anterior end of LIM/total length of segment x 100%.

Point locality records were georeferenced in the field with a portable GPS (Garmin® II Plus), or retroactively using the GeoNet Names Server (GNS; http://earth-info.nga.mil/gns/html/) or Google Earth (version 6.0.3.2197) and a distribution map generated with ArcMap 10.0 (Environmental Systems Research Institute [ESRI], Redlands, California), by superimposing point locality records of species on spatial datasets depicting political boundaries and a map of vegetation zones from the Arizona State Land Department (1993).

FIG. 1. *Vaejovis tenuipalpus*, n. sp., habitat and habitus. **A.** Habitat at type locality in the Hualapai Mountains, Arizona. **B.** Adult ♀, habitus in life.

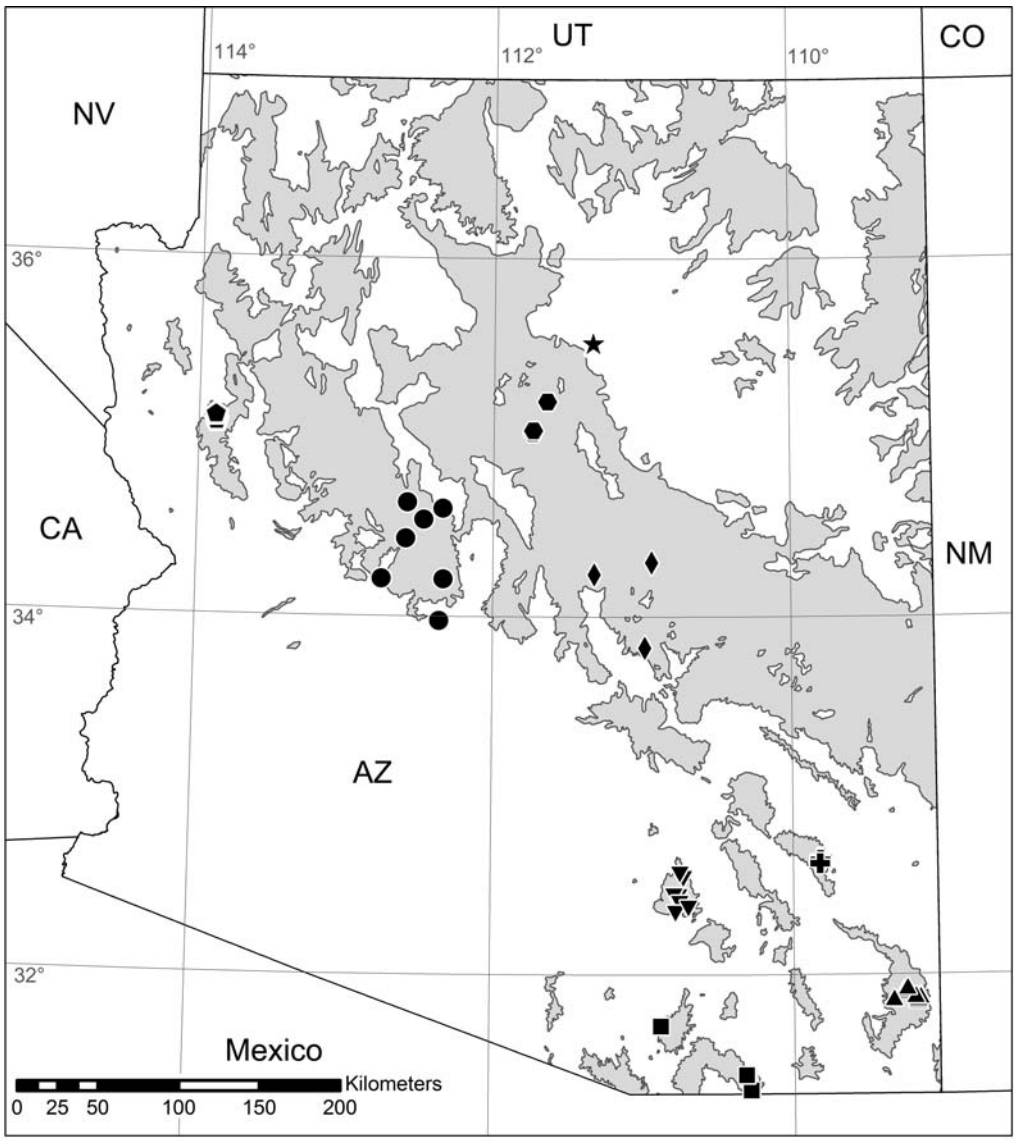

FIG. 2. Map of Arizona showing known distributions of species in the *vorhiesi* group of *Vaejovis* C.L. Koch, 1836, recorded in the state: *Vaejovis cashi* Graham, 2007 (triangles); *Vaejovis crumpi* Ayrey and Soleglad, 2011 (circles); *Vaejovis deboerae* Ayrey, 2009 (inverted triangles); *Vaejovis electrum* Hughes, 2011 (crosses); *Vaejovis jonesi* Stahnke, 1940 (star); *Vaejovis lapidicola* Stahnke, 1940 (hexagons); *Vaejovis paysonensis* Soleglad, 1973 (diamonds); *Vaejovis tenuipalpus*, n. sp. (pentagons); *Vaejovis vorhiesi* Stahnke, 1940 (squares). Contour interval indicates the lower limit of chaparral vegetation, approximately 1000 m.

SYSTEMATICS

Family Vaejovidae Thorell, 1876

Vaejovis tenuipalpus, n. sp.

Figures 1–5; tables 1–3

TYPE MATERIAL: **U.S.A.: Arizona:** *Mohave Co.*: Holotype ♂ (AMNH), Antelope Wash, Hualapai Peak, off Flag Mine Road, 1.7 mi. from intersection with Hualapai Mountain Road, 35°04′35.6″N 113°52′56.9″W, 2038 m, 8.ix.2007, L. Prendini and J. Huff, pine-oak forest on coarse, granitic sandy loam soil in dry ravine with dense oak and pine leaf litter. Paratypes: same data as holotype, 2 ♂, 9 ♀ (AMNH), 1 subad. ♂ (AMNH [LP 7191]); same locality, 35°04′35.4″N 113°52′54.8″W, 4.v.2010, R.W. Bryson, 4 ♀, 1 subad. ♂, 1 subad. ♀, 1 juv. ♀ (AMNH); 3 ♀, 1 juv. ♂, 4 juv. ♀ (CAS), 29.vii.2011, R.W. Bryson, 1 ♂ (CAS); Getz Peak, 1.7 km N of Hualapai Mountain Road, 35°06′40.86″N 113°53′10.42″W, 2212 m, 29.vii.2011, R.W. Bryson, 1 ♀ (CAS).

ETYMOLOGY: The specific name, derived from the Latin *tenuis*, meaning "slender," and *palpus*, referring to the pedipalp, describes a diagnostic character of this species.

DIAGNOSIS: *Vaejovis tenuipalpus*, n. sp., can be differentiated from similar species in the *vorhiesi* group of *Vaejovis* in morphometrics of the pedipalps and metasoma, macrosetal counts of the metasoma, pedipalp chela finger dentition, pedipalpal and metasomal carination, development of the subaculear tubercle, and morphology of the hemispermatophore.

The pedipalp chelae of *V. tenuipalpus,* n. sp., are distinctly more slender than those of *V. jonesi* and *V. lapidicola*, and all other species of the group: chela L/W ratio, 5.39–5.74 (♂), 5.00–5.39 (♀) in *V. tenuipalpus*, n. sp., compared with ≤ 5.00 (♂), ≤ 4.79 (♀) in all other species (table 2).

The metasoma of *V. tenuipalpus*, n. sp., is similar to that of *V. jonesi*, with metasoma III, L/W ratio, 1.31–1.47 (♂), 1.20–1.40 (♀) and metasoma V, L/W ratio, 2.65–2.92 (♂), 2.40–2.72 (♀), but distinctly more slender than that of *V. cashi*, *V. deboerae*, *V. electrum*, *V. lapidicola*, and *V. vorhiesi*, with metasoma III, L/W ratio, ≤ 1.34 (♂), ≤ 1.28 (♀) and metasoma V, L/W ratio, ≤ 2.50 (♂), ≤ 2.49 (♀) (table 2).

Vaejovis tenuipalpus, n. sp., has the same metasomal macrosetal counts as *V. jonesi*, but differs from the other species in having ventrolateral macrosetal counts of 2:2:2 on segments II–IV. *Vaejovis deboerae* has ventrolateral macrosetal counts of 3:3:3 on segments II–IV in 95% of specimens examined. *Vaejovis cashi*, *V. paysonensis*, and *V. vorhiesi* have three macrosetae on segment IV in 95% of specimens examined. Most *Vaejovis electrum* (80%) also have three macrosetae on this carina. *Vaejovis feti* has three macrosetae on segments III (95%) and IV (95%; one specimen examined had four macrosetae).

Vaejovis tenuipalpus, n. sp., like most species in the group, has a dorsolateral macrosetal count of 0:1:1:2. *Vaejovis feti* and *V. paysonensis* have dorsolateral macrosetal counts of 1:1:1:2 in 90% and 100% of specimens examined, respectively.

The basic macrosetal count for the ventral submedian carinae of metasomal segments I–IV in species of the *vorhiesi* group is 3:3:3:3. Several species, including *V. deboerae* (85% of specimens examined), *V. feti* (100%) and *V. lapidicola* (100%), display a tendency for additional

Table 1. Selected measurements (range, mean, and standard deviation) of ♂ (n = 4) and ♀ (n = 12) *Vaejovis tenuipalpus*, n. sp. Abbreviations as follows: Ca = carapace; Fem = pedipalp femur; FF = pedipalp chela fixed finger; L = length; Met = metasomal segment; MF = pedipalp chela movable finger; post = posterior; SD = standard deviation; W = width.

Structure	Sex	Range	Mean ± SD
Ca L	♂	3.04–3.35	3.22 ± 0.16
	♀	3.50–3.98	3.73 ± 0.15
Ca post W	♂	2.58–2.84	2.75 ± 0.10
	♀	3.09–3.52	3.30 ± 0.13
Met III L	♂	1.98–2.31	2.10 ± 0.18
	♀	2.03–2.38	2.16 ± 0.12
Met III W	♂	1.38–1.57	1.50 ± 0.10
	♀	1.55–1.80	1.66 ± 0.07
Met V L	♂	3.45–4.11	3.75 ± 0.33
	♀	3.70–4.31	3.98 ± 0.19
Met V W	♂	1.25–1.50	1.39 ± 0.11
	♀	1.47–1.65	1.55 ± 0.06
Fem L	♂	2.93–3.30	3.12 ± 0.18
	♀	3.14–3.65	3.42 ± 0.16
Fem W	♂	0.71–0.81	0.76 ± 0.05
	♀	0.84–0.96	0.89 ± 0.04
Chela L	♂	4.92–5.68	5.32 ± 0.38
	♀	5.43–6.29	5.88 ± 0.28
Chela W	♂	0.90–0.99	0.95 ± 0.04
	♀	1.04–1.22	1.14 ± 0.06
FF L	♂	2.55–3.02	2.83 ± 0.22
	♀	2.89–3.40	3.15 ± 0.16
MF L	♂	3.05–3.50	3.33 ± 0.23
	♀	3.35–4.01	3.70 ± 0.20

macrosetae either on the carinae and/or in the ventromedian intercarinal space. No specimens of *V. tenuipalpus* examined possessed extra carinal macrosetae or accessories, however.

Vaejovis tenuipalpus, n. sp., has three macrosetae on the dorsolateral carinae, two on the lateromedian carinae, and three on the ventrolateral carinae of metasomal segment V. Four ventrolateral macrosetae were observed in 65% of the specimens of *V. deboerae* examined, and four, five, or six ventrolateral macrosetae were observed in all specimens of *V. feti*.

Vaejovis tenuipalpus, n. sp., is similar to *V. deboerae* in having six inner accessory denticles on the pedipalp chela movable finger, whereas *V. crumpi*, *V. jonesi*, *V. lapidicola*, and *V. paysonensis* have seven.

All pedipalpal carinae are noticeably granular in *V. tenuipalpus*, n. sp. Within the *vorhiesi* group, only *V. bigelowi* from southwestern New Mexico, a smaller, yellowish species with robust

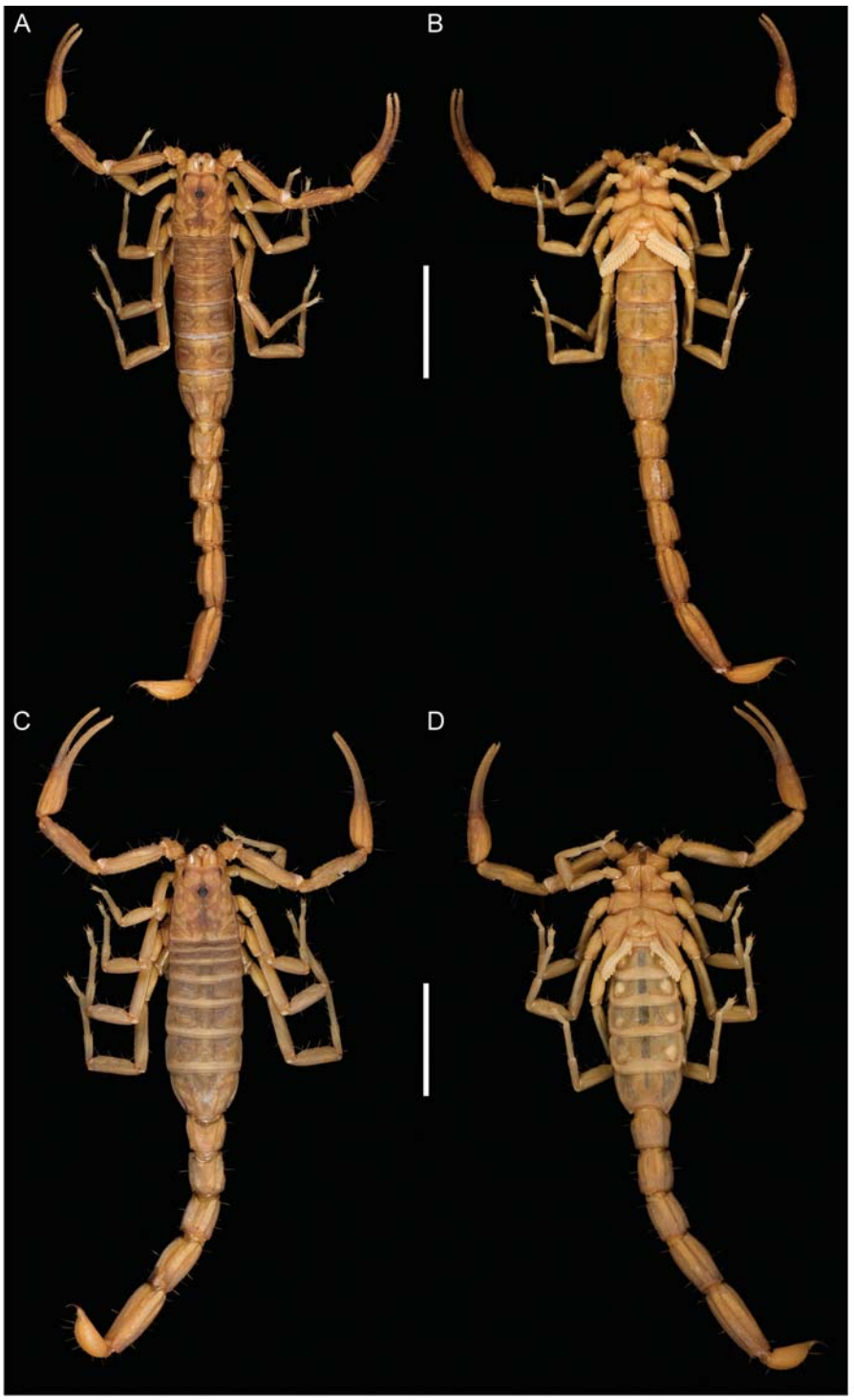

FIG. 3. *Vaejovis tenuipalpus*, n. sp., habitus. **A, B.** Holotype ♂ (AMNH). **C, D.** Paratopotype ♀ (AMNH). **A, C.** Dorsal aspect. **B, D.** Ventral aspect. Scale bars = 10 mm.

Table 2. Morphometric comparisons of *Vaejovis deboerae* Ayrey, 2009 (*n* = 10 ♂, 10 ♀), *Vaejovis jonesi* Stahnke, 1940 (*n* = 5 ♂ topotypes, holotype ♀), *Vaejovis lapidicola* Stahnke, 1940 (*n* = 10 ♂, 10 ♀), *Vaejovis tenuipalpus*, n. sp. (*n* = 4 ♂, 12 ♀), and *Vaejovis vorhiesi* Stahnke, 1940 (*n* = 10 ♂, 10 ♀). Abbreviations as follows: Ca = carapace; Fem = pedipalp femur; FF = pedipalp chela fixed finger; L = length; Met = metasomal segment; MF = pedipalp chela movable finger; W = width.

Ratio	Sex	*V. deboerae*	*V. jonesi*	*V. lapidicola*	*V. tenuipalpus*	*V. vorhiesi*
Ca L/Met V L	♂	0.85–0.89	0.79–0.85	0.89–0.97	0.81–0.88	0.87–0.93
	♀	0.92–0.98	0.89	0.93–1.00	0.91–0.98	0.92–1.03
Met III L/W	♂	1.08–1.18	1.33–1.50	1.22–1.34	1.31–1.47	1.13–1.31
	♀	1.02–1.14	1.34	1.11–1.28	1.20–1.40	0.84–1.24
Met V L/W	♂	2.24–2.31	2.49–2.79	2.24–2.50	2.65–2.92	2.19–2.46
	♀	2.10–2.32	2.56	2.18–2.49	2.40–2.72	2.06–2.44
Fem L/W	♂	3.11–3.33	3.68–4.17	3.32–3.61	4.01–4.14	3.00–3.67
	♀	3.00–3.33	3.83	3.24–3.65	3.65–3.94	3.00–3.38
Chela L/W	♂	4.17–4.58	3.38–4.07	3.78–4.20	5.39–5.74	4.50–5.00
	♀	4.21–4.79	3.95	4.20–4.73	5.00–5.39	4.10–4.73
FF L/Ca L	♂	0.69–0.76	0.77–0.84	0.76–0.84	0.82–0.90	0.62–0.74
	♀	0.71–0.77	0.82	0.79–0.89	0.81–0.89	0.64–0.75
FF L/Chela L	♂	0.48–0.51	0.49–0.51	0.49–0.51	0.51–0.54	0.47–0.51
	♀	0.48–0.52	0.51	0.50–0.54	0.52–0.55	0.49–0.52

pedipalp chelae, exhibits this condition, but the granulation of its carinae is more pronounced.

In *V. tenuipalpus*, n. sp., the lateral inframedian carinae (LIM) of metasomal segment II are restricted to the posterior 32%–61% (*n* = 10) of the segment, and usually continue anteriorly as an irregular row of granules (the extent is less than 40% in only one of 10 specimens). In *V. jonesi*, the LIM carinae are restricted to the posterior 31%–40% (*n* = 5) of the segment, without anterior continuation. The extent of these carinae on segment III is similar in the two species, the carinae being restricted to the posterior 20%–39% of the segment in *V. tenuipalpus*, n. sp., and to the posterior 19%–38% in *V. jonesi*, without anterior continuation.

The subaculear tubercle of *V. tenuipalpus*, n. sp., is minute, whereas those of *V. cashi* and *V. deboerae* are prominent and angular.

The hemispermatophore of *V. tenuipalpus*, n. sp., differs from those of the morphologically similar species, *V. cashi*, *V. crumpi*, *V. deboerae*, *V. electrum*, *V. lapidicola*, *V. paysonensis*, and *V. vorhiesi* in lacking a sperm plug. The hemispermatophore of *V. tenuipalpus*, n. sp., is most similar to those of *V. feti* and *V. jonesi*, which lack the sperm plug. The hemispermatophore of the holotype and only known male of *V. bigelowi* has not been dissected for study.

Description: Based on the holotype male (fig. 3A, B), except as indicated. Hemispermatophore was dissected from a paratopotype male.

Total length: Adult 25.69 mm in length.

Color: Base coloration yellowish brown with faint infuscation on carapace, tergites, pedipalps, telson, and legs.

Prosoma: Carapace distinctly emarginate anteriorly; surfaces densely and finely granular, more coarsely granular on infuscated areas. Sternum with four anterior macrosetae, one pair of medial macrosetae, and one pair of lateral macrosetae.

Mesosoma: All tergites with pretergites shagreened, posttergites densely and finely granular with dense coarse granulation on infuscated areas. Tergites with median carina absent on I, weak on II–III, moderate on IV–VII; VII with moderate, granular median carina and two pairs of moderate, serratocrenulate lateral carinae. Pectinal tooth count 12/12. Sternites densely and finely granular; V with wide, thin pale patch along posterior edge, its anterior margin weakly convex; VII with lateral carinae moderate, crenulate, and 10 nonmarginal macrosetae (one pair at anterior ends of lateral carinae, one pair at posterior ends of lateral carinae, one pair located anteriorly between carinae and lateral margins, one small anterior pair in medial intercarinal space, and two smaller, unpaired posterior macrosetae in medial intercarinal space).

Metasoma: Segment I, L/W ratio, 1.00; II, L/W ratio, 1.28; V, L/W ratio, 2.72. Segments I–IV: Dorsolateral carinae strong, serratocrenulate (fig. 4E). Lateral supramedian carinae strong, crenulate. Lateral inframedian carinae, segment I complete, strong, irregularly crenulate; II, present on posterior 44% of segment, strong, crenulate, with weak row of anteriorly directed granules; III, present on posterior 32%, strong, irregularly crenulate; IV, absent. Ventrolateral carinae moderate, serratocrenulate on segments I and II, crenulate on III and IV. Ventral submedian carinae moderate, crenulate to serratocrenulate. Carinal macrosetae (I:II:III:IV): dorsolateral, 0/0:1/1:1/1:2/2; lateral supramedian, 0/0:1/1:1/2:2/2; lateral inframedian, 1/1:0/0:0/0:0/0; ventrolateral, 2/2:2/2:2/2:2/2; ventral submedian, 3/3:3/3:3/3:3/3; ventromedian accessory setae absent. All intercarinal surfaces densely, finely granular; dorsal surfaces and, to a lesser extent, dorsolateral surfaces with sparse coarse granulation. Segment V: Dorsolateral carinae stronger anteriorly, moderate posteriorly, granular. Lateromedian carinae present on anterior four-fifths, strong, serratocrenulate. Ventrolateral and ventromedian carinae strong, serratocrenulate to serrate. Carinal macrosetae: dorsolateral, 3/3; lateromedian, 2/2, ventrolateral, 3/3; ventromedian, 1+2/1+2, represented by 1 anterior pair, 1 pair slightly anterior to midsegment, and 1 posterior pair (anterior pair immediately flanking ventromedial carina, others laterally offset from carina). Intercarinal surfaces densely, finely granular with sparse coarse granulation on all surfaces.

Telson: Vesicle, dorsal surface with elongate white patch extending from midtelson to base of aculeus (fig. 4E); ventral surface with moderately dense, low, rounded granules associated with infuscated areas; eight pairs of large, pigmented macrosetae. Subaculear tubercle minute.

Pedipalps: Trichobothrial pattern Type C, orthobothriotaxic. Femur L/W ratio, 4.14. Dorsointernal carina strong, crenulate (fig. 4G); dorsoexternal carina strong, irregularly crenulate; ventrointernal carinae strong, serrate; ventroexternal carina moderate, irregularly serrate. All intercarinal surfaces densely, finely granular; internal surface with irregular row of strong, pointed granules; ventral surface with dense coarse granulation proximally; external surface with sparse, irregular coarse granulation. Internal surface with 1 supramedial macroseta and 3 inframedial macrosetae; external surface with 2 medial macrosetae.

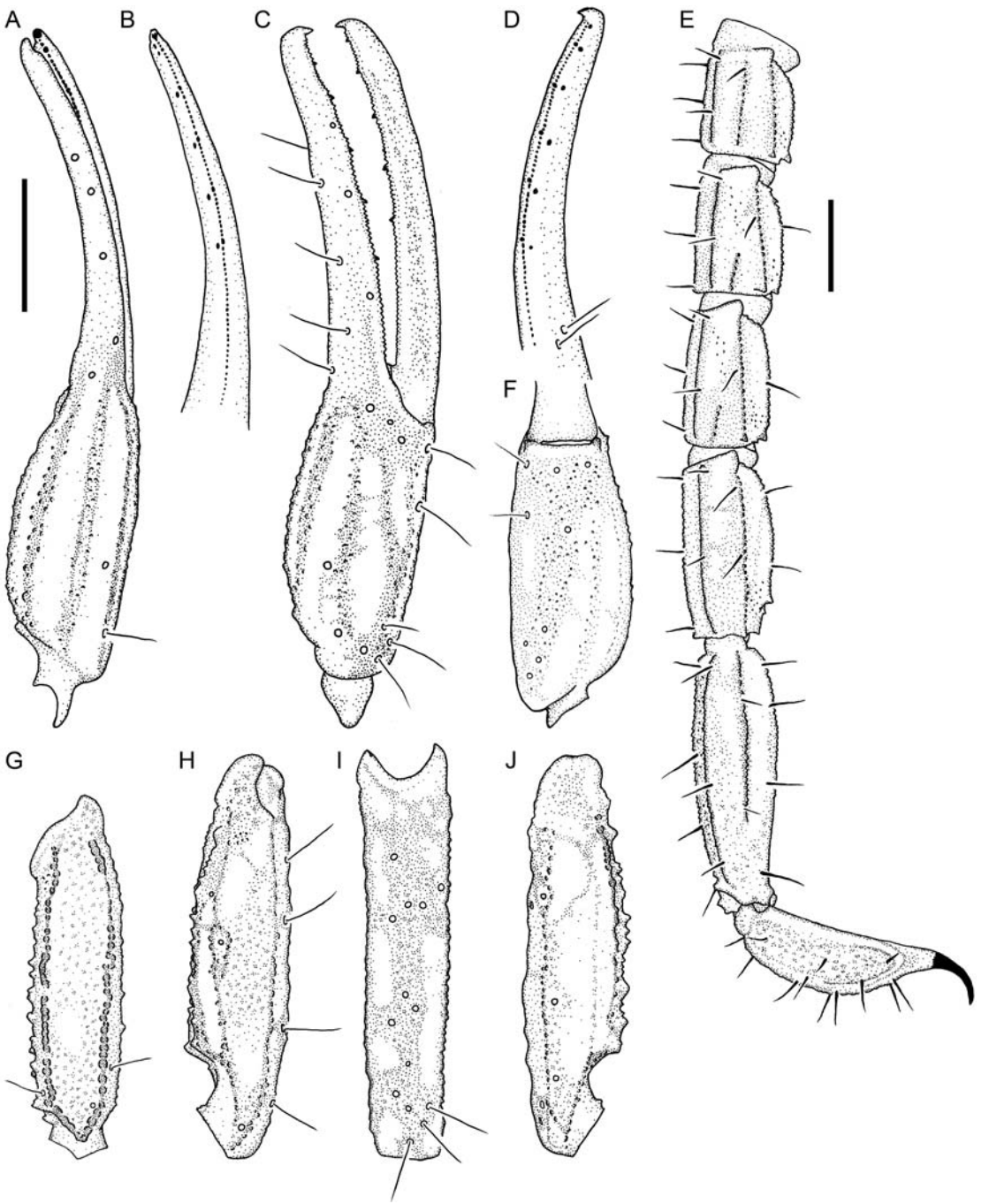

FIG. 4. *Vaejovis tenuipalpus*, n. sp., holotype ♂ (AMNH), dextral pedipalp segments, illustrating trichobothrial patterns (**A–D, G–J**), metasoma and telson (**E**). **A, C.** Chela. **B.** Chela movable finger, opposable dentate margin. **D.** Chela fixed finger, opposable dentate margin. **E.** Metasoma and telson. **F.** Chela manus. **G.** Femur. **H–J.** Patella. **A, B, G, H.** Dorsal aspect. **C, I.** External aspect. **D, F, J.** Ventral aspect. **E.** Lateral aspect. Scale bars = 1 mm.

Patella L/W ratio, 4.11. Dorsointernal, dorsoexternal and ventroexternal carinae strong, irregularly crenulate (fig. 4H–J); internal carina strong, composed of enlarged spiniform granules; ventrointernal carina strong, serrate. All intercarinal surfaces densely, finely granular; external and ventral surfaces with sparse coarse granulation. Internal surface with 3 supramedial macrosetae and 3 inframedial macrosetae.

Chela palm slender (fig. 4A, C, F); chela L/W ratio, 5.49; movable finger L/chela W ratio, 3.36; fixed finger L/carapace L ratio, 0.85; movable finger L/metasomal segment V L ratio, 0.90. Dorsointernal, dorsal marginal, dorsal secondary, digital, and ventroexternal carinae moderate, granular; external secondary, ventromedian and ventrointernal carinae weak, granular. Dorsal intercarinal surfaces concave, such that dorsal carinae appear as distinctly elevated ridges. Surfaces of chela palm and fingers densely, finely granular; most coarse granulation associated with carinae, with additional granulation ventrointernally at base of movable finger and internal base of fixed finger, in vicinity of trichobothria *ib* and *it*. Fixed finger primary denticle row divided into six subrows by five enlarged primary row denticles (fig. 4D); six inner accessory denticles (basalmost on dextral side reduced); trichobothria *ib* and *it* located at base of fixed finger. Movable finger primary denticle row divided into six subrows by five enlarged primary row denticles (fig. 4B); six inner accessory denticles.

Legs: Trochanters densely granular on prolateral surfaces. Femora and patellae carinate, surfaces with coarse dense granulation. Tibiae and basitarsi lightly granular, with weak carinae. Basitarsus I, proventral spinule row with few spinules situated between three large macrosetae, retroventral spinule row complete, uninterrupted by setae, retrolateral spinule row absent; II with sparse retroventral spinule row; III and IV lacking spinule rows. Telotarsus III, ventromedian spinule row terminating between single pair of larger spinules. Fourteen macrosetae, excluding superoterminal landmark macroseta, as follows: *ri*, 1; *rid*, 1; *rit*, 1 *rm*, 1; *rmt*, 1; *rs*, 1; *rst*, 2; *pi*, 1; *pid*, 1; *pit*, 1; *pm*, 1; *ps*, 1; *pst*, 1.

Hemispermatophore: Distal lamina, slightly tapered to distal end; lamina L/trunk L ratio, 2.64; lamina L/maximum W ratio, 5.12; ventrodistal crest absent (fig. 5A). Sclerotized sperm plug absent. Bifurcated laminar hook (fig. 5B, C) located on dorsal aspect near base of distal lamina.

Measurements: Holotype ♂ (AMNH): Total L, 25.69. Carapace, L, 3.04; posterior W, 2.64. Mesosoma, L, 7.91. Metasoma, L, 11.55; segment I, L/W, 1.60/1.60; II, L/W, 1.88/1.47; III, L/W, 1.98/1.39; IV, L/W, 2.64/1.32; V, L/W, 3.45/1.27. Telson, L, 3.19; vesicle, L/W/H, 2.13/1.06/0.86; aculeus, L, 1.06. Pedipalp femur, L/W, 2.94/0.71; patella, L/W, 3.12/0.76; chela, L/W/H, 4.92/0.91/0.99; fixed finger, L, 2.59; movable finger, L, 3.09; manus (along ventroexternal carina), L, 1.98.

Paratype ♀ (AMNH): Total L, 30.73. Carapace, L, 3.84; posterior W, 3.43. Mesosoma, L, 9.60. Metasoma, L, 13.50; segment I, L/W, 1.89/1.99; II, L/W, 2.17/1.87; III, L/W, 2.27/1.87; IV, L/W, 3.03/1.62; V, L/W, 4.14/1.62. Telson, L, 3.79; vesicle L/W/H, 2.53/1.46/1.14; aculeus, L, 1.26. Pedipalp femur, L/W, 3.64/0.96; patella, L/W, 3.89/1.01; chela, L/W/H, 6.31/1.21/1.24; fixed finger, L, 3.43; movable finger, L, 4.04; manus (along ventroexternal carina), L, 2.47.

Variation: Morphometric variation among males and females of *V. tenuipalpus*, n. sp., is summarized in tables 1 and 2. Unlike other species of the *vorhiesi* group, the male pedipalp

segments of *V. tenuipalpus*, n. sp., are more slender than those of females. Although only four adult males were available for analysis, the trend was observed in all of them, compared to the 12 females measured.

Pectinal tooth counts were as follows: ♂: 12 combs with 12 teeth, 1 comb with 11 teeth, and 1 comb with 10 teeth; ♀: 4 combs with 12 teeth, 22 combs with 11 teeth, 16 combs with 10 teeth, and 4 combs with 9 teeth.

Modal counts of macrosetae (n = 20) were as follows for metasomal segments I–IV (I:II:III:IV): dorsolateral carinae, 0:1:1:2; lateral supramedian carinae, 0:1:1:2; lateral inframedian carinae, 1:0:0:0; ventrolateral carinae, 2:2:2:2; and ventral submedian carinae, 3:3:3:3; and for segment V: dorsolateral carinae, 3; lateromedian carinae, 2; ventrolateral carinae, 3; ventromedian carinae, one anterior submedial pair, one medial lateral pair, and one posterior sublateral pair (designated as 1+2 using convention of Santibañez-Lopez and Sissom, 2010). Individual variation in setal formula for 20 specimens is shown in table 3.

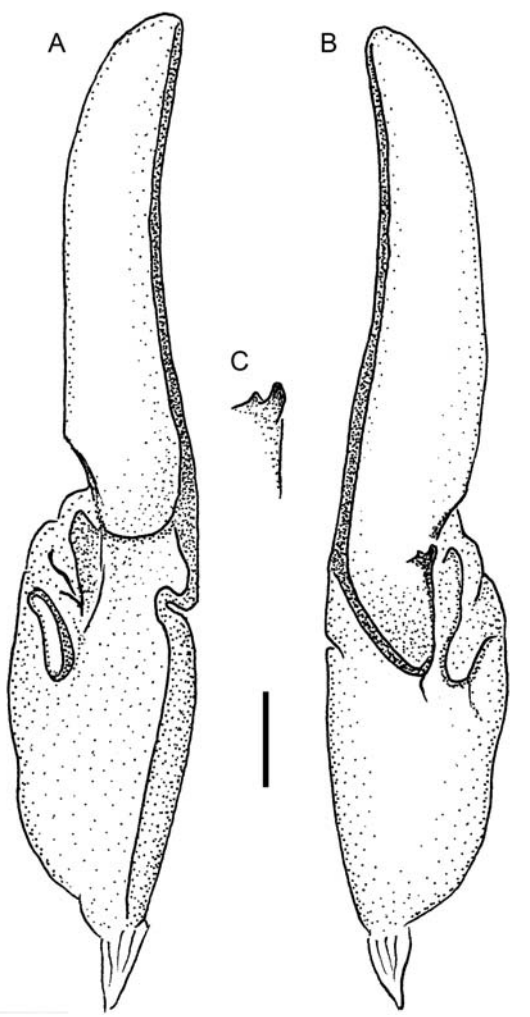

FIG. 5. *Vaejovis tenuipalpus*, n. sp., paratopotype ♂ (AMNH), dextral hemispermatophore. **A.** Ventral aspect. **B.** Dorsal aspect. **C.** Detail of dorsal hooks. Scale bar = 1 mm.

No variation in macrosetae was observed on the pedipalp femur; all 20 specimens exhibited the following macrosetae: one internal supramedian, three internal inframedian, and two external median. All 20 specimens had three internal supramedian macrosetae on the pedipalp patella, but 10 specimens had two internal inframedian macrosetae and 10 had three (in several cases the median seta was reduced in size).

The fixed finger of the pedipalp chela had six subrows in the primary denticle row in all specimens (n = 58 fingers); 42 fixed fingers had six inner accessory denticles, 13 had five, one had four, and two could not be counted. Fifty-three movable fingers had six subrows, three had five, and two could not be counted; 49 movable fingers had six inner accessory denticles, one had seven, six had five, and two could not be counted.

The lateral inframedian carinae (n = 10) of segment II occupied the posterior 32%–61% (mean = 44.1%); in nine of the 10 specimens, there were either several anterior granules or a

Table 3. Variation in macrosetal formulas for carinae of metasomal segments I–IV (I:II:III:IV) and V. Numbers below formula indicate the number of observations (n = 20) and percentage of occurrence. Modal counts are highlighted in **boldface**. "?" indicates a damaged segment with an uncertain count. Abbreviations as follows: DL = dorsolateral; LIM = lateral inframedian; LM = lateromedian; LSM = lateral supramedian; VL = ventrolateral; VM = ventromedian; VSM = ventral submedian.

	Metasomal Segments I–IV				
DL	0:0:1:1 / 0:0:1:? 2 (10%)	0:0:1:2 2 (10%)	0:1:1:1 2 (10%)	**0:1:1:2** **13 (65%)**	0:1:2:2 1 (5%)
LSM	0:1:1:1 1 (5%)	**0:1:1:2** **19 (95%)**			
LIM	**1:0:0:0** **20 (100%)**				
VL	**2:2:2:2** **19 (95%)**	2:2:2:3 1 (5%)			
VSM	**3:3:3:3** **19 (95%)**	3:3:3:4 1 (5%)			
	Metasomal Segment V				
DL	**3** **17 (85%)**	3? 1 (5%)	4 2 (10%)		
LM	**2** **20 (100%)**				
VL	**3** **19 (95%)**	4 1 (5%)			
VM	**1+2** **20 (100%)**				

weak row of anterior granules, directed anteroventrally. The LIM carinae of segment III occupied the posterior 20%–39% (mean = 29.4%); only one specimen possessed a few anterior granules. The LIM carinae of segment IV were absent in all 10 specimens.

Dissection of a second hemispermatophore confirmed the absence of the sperm plug as well as the shapes of the distal lamina and lamellar hooks that were observed in the paratopotype.

Distribution: This species is known only from two mountain peaks within the Hualapai Mountains (Mohave County, Arizona), to which it is presumed to be endemic (fig. 2).

Ecology: All but one *V. tenuipalpus*, n. sp., were collected in the heavily wooded Antelope Wash below Hualapai Peak (fig. 1A); the habitus of a live female from that locality is shown in figure 1B. All specimens from the September 2007 series were collected during the day under large loose rocks in rock piles, and lying on oak leaf litter, mostly in the shade of large trees in the wash. Several were resting on the undersurfaces of rocks (negative geotaxis). The specimens

in the May 2010 series were also found during the day, beneath rocks lying on deep oak leaf litter at the bottom of a rocky slope. One female was found at night on a rock cut on the dirt road leading up to Getz Peak from Hualapai Mountain Road. The habitat there was distinctly different than the habitat in Antelope Wash, and consisted primarily of dense low-growing shrubs and few scattered pine trees. A single small juvenile *Paruroctonus* sp., related to *Paruroctonus becki* (Gertsch and Allred, 1965), was collected at the same locality in July 2011.

COMPARATIVE MATERIAL EXAMINED

Vaejovis bigelowi Sissom, 2011: **U.S.A.: New Mexico:** *Hidalgo Co.*: Granite Gap (pass through Peloncillo Mts. on NM 80), 11.1 mi. S Road Forks, 3.viii.1989, Sissom, Colwell, and Fitzpatrick, 1 subad. ♀ paratype (AMNH), 4.viii.1989, W.D. Sissom, holotype ♂ (AMNH), 13.vi.2001, M. Graham, paratype ♀ (AMNH).

Vaejovis cashi Graham, 2007: **U.S.A.: Arizona:** *Cochise Co.*: Ash Spring, 6 mi. SW Portal, iv.1965, B. and C. Durden, 1 ♀ (AMNH); Ash Spring, 1 mi. NW Herb Martir Dam (8 mi. W Portal), 31.vii.1965, R. Hastings, 1 ♀ (AMNH); Barfoot, 1.viii.1955, W. Gertsch, 1 ♀ (AMNH); Barfoot Lookout, trail to, 8520 ft., 16.vii.1971, J. Cole and T. Ryan, 1 ♂ (AMNH); Barfoot Meadow, 8.ix.1963, Gertsch and Roth, 2 ♂, 6 ♀ (AMNH); Barfoot Park, 10 mi. W Portal, 19.vii.1964, Gertsch and Woods, 1 ♂, 1 ♀ (AMNH), 16.viii.1964, Hastings, 2 ♀ (AMNH), 27.vi.1967, Gertsch and Hastings, 1 ♀ (AMNH); Cave Creek Canyon, 0.1 mi. E Stewart Camp, 3.vi.1973, O.F. Francke, 1 juv. ♂, 7 ♀ (AMNH), 0.4 mi. W Stewart Camp, 3.vi.1973, O.F. Francke, 1 ♂, 9 ♀ (AMNH), 0.7 mi. W Stewart Camp, 3.vi.1973, O.F. Francke, 1 juv. ♂, 4 ♀ (AMNH); Cave Creek Canyon, iv.1965, B. and C. Durden, 1 ♀ (AMNH); Cave Creek Canyon, 5 mi. W Portal, 14.viii.1974, Cazier family, 1 ♂, 3 ♀, 13 first instars (AMNH); Cave Creek Canyon, 6.5 mi. W Portal, 14.vi.1973, O.F. Francke, 2 ♂, 23 ♀ (AMNH); Cave Creek, South Fork, 11.ix.1950, W. Gertsch, 3 ♂, 4 ♀ (AMNH), 17–19.iv.1961, W. Gertsch, 1 ♂, 4 ♀ (AMNH), 10.ix.1964, J. and W. Ivie, 1 ♂ (AMNH); Cave Creek, South Fork, 4 mi. W Portal, 9.ix.1964, W. Gertsch, 2 ♀ (AMNH); Cave Creek, South Fork, 31.53°N 109.11°W, 10.ix.1964, J. and W. Ivie, 3 juv. (AMNH); Cave Creek, South Fork, 5000 ft., 22.vii.1969, Cazier and Bigelow, 2 ♂, 1 ♀ (JLB); Cave Creek, South Fork, ca. 5 mi. S Portal, 30.v.1976, B. Warner, 7 ♀ (AMNH); South Fork, 6–13.v.1956, M. Statham, 1 ♀ (AMNH), 13.vii.1963, V. Roth, 1 ♀ (AMNH); South Fork, 5 mi. W Portal, 17.iv.1964, V. Roth, 1 ♀ (AMNH); Chiricahua Mts., 16–19.vii.1952, Cazier and Schrammel, 3 ♀ (AMNH), viii.2004, D. Vernier, 4 ♀ (AMNH [LP 3111]); Chiricahua National Monument, roadcuts, campground, 6000 ft., 16.vii.1970, Cazier, Welch, and Bigelow, 45 ♂, 33 ♀ (JLB); East Turkey Creek, 6300 ft., 29.vii.1972, R. Zweifel; East Turkey Creek, 6400 ft., 11.x.1961, E. Maynard, 1 ♂, 1 juv. (AMNH), 1 ♀ (AMNH); East Turkey Creek, 6600 ft., 3. vi.1973, O.F. Francke, 4 ♂, 2 ♀ (AMNH). East Turkey Creek crossing, 3 mi. SW Paradise, 20.vi.1973, O.F. Francke, 2 ♂, 16 ♀ (WDS); Long Park, 1 mi. S, 28.vi.1969, Gertsch and Hastings, 3 ♀ (AMNH); Onion Saddle Road to Portal, East Turkey Creek, 22.v.1970, Cazier and Bigelow, 13 ♂, 6 ♀ (JLB); Pinery Canyon, 8.ix.1950, W. Gertsch, 1 ♀ (AMNH); Portal, 3 mi. SW, 1.iv.1966, B. Vogel, in leaf litter, 1 juv. (AMNH), 16.v.1966, B. Vogel, 1 ♂, 2 ♀ (AMNH);

Portal, 5 mi. W, 4.vii.1956, E. Ordway, 1 ♀ (AMNH); Portal, 7 mi. W, 4.viii.1955, W. Gertsch, 1 ♀ (AMNH); Portal, 8 mi. W, towards falls, 8.iv.1963, V. Roth, 2 ♂, 1 ♀ (AMNH); Portal, 8 mi. W, 6000–6500 ft., on banks of roadcuts, rocky substrate and dead plant material, 14. viii.1976, Cazier family, 65 ♂, 3 ♀ (AMNH); Portal, 12–15 mi. W, Onion Saddle to 3 mi. SE Onion Saddle, roadcuts, 21.vii.1969, Cazier, et al., 10 ♂, 100 ♀ (JLB); Rustler Camp, 9.ix.1950, W. Gertsch, 1 ♂, 5 ♀, 4 juv. (AMNH); Rustler's Camp, 1.vi.1952, Cazier, Gertsch, and Schrammel, 8 ♂, 30 ♀ (AMNH); Rustler Park, 8500 ft., 25–26.viii.1952, B. Malkin, 7 ♂, 7 ♀, 4 juv. (AMNH); Rustler Park, 15–16.ix.1952, B. Malkin, 3 ♀ (AMNH), 30.vii.1955, W. Gertsch, 1 ♂, 3 ♀ (AMNH), 1.viii.1955, E. Ordway, 1 ♂, 3 ♀ (AMNH), 25.ii.1957, E. Ordway, 1 ♀ (AMNH); 26.v.1961, M. Cazier, 1 ♀ (AMNH), 12.vi.1962, C. Parrish, 1 ♀ (AMNH), 17.viii.1963, V. Roth, 1 ♀ (AMNH), 22.viii.1963, M. Muma, 1 ♀, 8 first instars (AMNH), 31.viii.1964, 1 ♂, 1 ♀, 14 first instars (AMNH); Rustler Park to 1.5 mi. N of park along roadcuts, outcrops, cliffs, 22. vii.1969, Cazier, et al., 45 ♂, 12 ♀, 1 juv. (JLB); Rustler Park, 8850 ft., 22.viii.1956, A.F. Archer, 2 ♀ (AMNH); Road 42D to Rustler's Park and Barfoot Park, 31°54.819′N 109°16.047′W, 24.viii.2007, M. Rubio, under rocks on open hillside, 3 ♀, 1 subad. (AMNH [LP 7228]); Portal, 5 mi. SW at Southwestern Research Station [SWRS], 1666 m, 22.vii.2007, J. Huff, under rocks and UV detection in pine forest, 1 subad. (AMNH [LP 7018]); SWRS, 5 mi. W Portal, 5–15. viii.1955, W. Gertsch, 1 ♀ (AMNH), 21.iii.1960, W. Gertsch, 1 ♀ (AMNH), vii.1960, Zweifel et al., 6 ♂ (AMNH), 2 ♀ (AMNH), 29.vii.1960, J. Cole, can traps, 2 ♀, 14 first instars (AMNH), 22.iv.1961, J. Rozen and R. Schrammel, 1 ♀ (AMNH); Turkey Creek, 6000 ft., 31.v.1952, Cazier, Gertsch, and Schrammel, 2 ♂, 16 ♀ (AMNH), 28.vi.1967, Gertsch and Hastings, 1 ♀ (AMNH).

Vaejovis crumpi Ayrey and Soleglad, 2011: **U.S.A.: Arizona:** *Yavapai Co*.: Castle Hot Springs, 30 mi. NW Phoenix, ca. 33°58.5′N 112°21.5′W, 4.iv.2006, R.C. West, under rocks, 1 ♀ (AMNH [LP 6214]); Crown King, 34°12.5′N 112°20′W, 18.v.1969, G. Bowden, 2 ♀ (CAS); 4134 Kachina Way, Prescott Valley, NNE Prescott, 34°36.15′N 112°20.4′W, 1.i.2005, M. Bell and S. Sensabaugh, on baseboard in bathroom of house, rainy and/or snow for several days, 1 ♀ (AMNH [LP 3985]); Prescott, ca. 8.5 mi. NW, 8500 ft., 15.viii.1972, R. Thomas, 1 ♀ (FSCA); Prescott, 10 mi. SW, 12.ix.1962, V. Roth, 1 ♂, 3 ♀ (AMNH); Yarnell, 1 mi. SE, 34°12′30.6″N 112°44′56.04″W, 4700 ft., 23.iii.2009, C. Kristensen, 2 ♀ (AMNH [LP 9598]).

Vaejovis deboerae Ayrey, 2009: **U.S.A.: Arizona:** *Pima Co*.: Bear Canyon Campground, 6500 ft., 24.vii.1965, W.J. Gertsch and R. Hastings, 3 ♂, 2 ♀ (AMNH); Coronado National Forest, Santa Catalina Hwy, on and near Bear Wallow Road, between mile marker 22 and 23, rocky road cut slopes, 32°24.495′N 110°43.317′W, 2375 m, 22.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 4 ♂, 10 ♀ (AMNH), 1 ♀ (AMNH [LP 5872]); Coronado National Forest, Santa Catalina Hwy, on and near Incinerator Road, between mile marker 19 and 20, granitic rocky road cut slopes, 32°24.664′N 110°43.325′W, 2464 m, 22.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 6 ♂, 2 ♀, 1 subad. ♀ (AMNH); Gen. Hitchcock Tree, 26.viii.1951, T. Cohn, 1 ♀ (AMNH); Molino Basin, on road to Mt. Lemmon, 5000–6000 ft., 19.viii.1995, P. Hyden and D. Wagner, 1 ♂ (WDS); Mount Lemon, top of, 9200 ft., 15.viii.1974, E. Minch, 1 ♂ (AMNH); Mt. Lemmon, 12.iv.1936, O. Bryant, 1 ♀ (AMNH), 25.v.1937, O. Bryant, 1 ♂, 4 ♀ (AMNH), 1.x.1938, O. Bryant, 2 ♀ (AMNH), 19.vi.1954, B. and

J. Liming, 1 ♀ (CAS), 1 ♀ (CAS), 8.iii.1968, H.L and L.L. Stahnke, 1 ♂ (CAS), 1 ♂ (CAS), 1 ♂ (CAS); Mt. Lemmon, 32°24′38.25″N 110°42′53.27″W, 7938 ft., 15.vi.2007, Z. Valois, 1 ♂, 2 ♀, 1 subad. ♀ (AMNH), 1 ♀ (AMNH [LP 7092]); Mt. Lemmon, vic. Summerhaven, 32.24°N 110.45°W, 21.v.1963, W.J. Gertsch and W. Ivie, 1 ♀, 3 subad. ♀, 2 juv. (AMNH); Oracle, 5 mi. S, 25.vii.1949, W.J. and J.W. Gertsch, 1 juv. (AMNH); Peppersauce Cave Canyon, 21.iv.1961, W.J. Gertsch, 4 ♀ (AMNH); Rose Lake, 6.x.1973, E. Oliver, 1 ♂ (AMNH); Sabino Canyon, 6.vi.1952, M. Cazier, W. Gertsch, and R. Schrammel, 1 ♂ (AMNH), 8.vi.1955, R.B. and J.M. Selander, 1 ♀ (AMNH); Santa Catalina Mts., Mt. Lemmon, 19.vi.1954, B. and J. Liming, 1 ♀ (CAS); Summerhaven, 22.viii.1950, M.A. Cazier, 1 ♀ (AMNH), 6.vi.1952, M. Cazier, W. Gertsch, and R. Schrammel, 4 ♀ (AMNH), 10.ix.1963, W.J. Gertsch and V. Roth, 1 ♀, 1 subad. ♀ (AMNH); Tucson, O. Bryant, 1 ♀ (AMNH); Tucson, Upper Bear Canyon, 15.vi.1973, D. Richman, 1 ♀ (AMNH).

Vaejovis electrum Hughes, 2011: **U.S.A.: Arizona:** *Graham Co.:* Arcadia Campground, 4.iv.1969, G.J. Doleyard, 2 ♀ (AMNH); Arcadia Campground, 31.v.2000, W.D. Sissom et al., 1 ♂, 16 ♀ (USNM); Arcadia Campground, 1.6 mi. S, 32°38.167′N 109°49.453′W, 7150 ft., 31.v–1.vi.2000, W.D. Sissom et al., 1 ♂ (WDS); Cluff Dairy turnoff, Swift Trail Road, deep in Ponderosa pine log on ground, 7400 ft., 10.vii.1966, W.L. Minckley, 4 ♀ (AMNH); Cottonwood, 4 mi. SW, 8.vi.1973, O.F. Francke, 1 ♂, 1 ♀ (AMNH); Mt. Graham, 0.9 mi S Arcadia Campground, 32°38.633′N 109°49.102′W, 31.v–1.vi.2000, W.D. Sissom et al., 1 ♂, 3 ♀ (WDS); Pinaleño Mts., Wet Canyon, Forest Camp, Mt. Graham, 12–13.ix.1952, B. Malkin, 3 ♂, 6 ♀ (AMNH); 9000 ft., 10.ix.1937, O. Bryant, 1 ♂, 1 ♀ (AMNH); 15.ix.1940, O. Bryant, 2 ♂, 2 ♀, 12 first instars (AMNH); 7400 ft., 10.ix.1937, O. Bryant, 2 ♀ (AMNH); 16.viii.1933, O. Bryant, 1 ♂ (AMNH); Pinaleño Mts., Hwy 366 into Coronado National Forest climbing Mount Graham just past mile marker 126, 11.8 mi. from junction Hwy 191, 32°38′33.1″N 109°49′06.2″W, 1684 m, 25.vii.2007, J. Huff, under rocks in pine forest, 1 ♀ (AMNH [LP 7019]); Pinaleño Mts., Hwy 366 into Coronado National Forest climbing Mount Graham, "Ladybug Trail No. 329" at mile marker 131, 16.5 mi from junction Hwy 191, 32°37′21″N 109°49′24.2″W, 2600 m, 25.vii.2007, J. Huff, under rocks in pine forest, 1 ♀ (AMNH [LP 7020]); Pinecrest, 13.ix.1950, W.J. Gertsch, 1 ♂ (AMNH), 2 ♂, 6 ♀, 1 juv. (AMNH); Safford, S of, 2.ix.1973, R. Kempton, 1 ♂, 1 ♀ (AMNH); Turkey Flat, 15.ix.1973, R. Kempton, 3 ♂, 2 ♀, 10 juv. (AMNH); Wet Canyon, under rock on south-facing slope, 100 ft. above stream, 6370 ft., 15.vi.1967, K. Brown, 1 ♀ (AMNH).

Vaejovis feti Graham, 2007: **U.S.A.: New Mexico:** *Grant Co.*: Meadow Creek, ca. 10 mi. NNE Pinos Altos, 16.vii.1976, M.H. Muma, 2 ♂, 2 ♀, 1 juv. (CAS), 16.vi.1977, M.H. Muma, 2 ♂, 3 ♀ (AMNH), 17.vii.1978, M.H. Muma, 3 ♂, 3 ♀ (WDS), 5.viii.1978, M.H. Muma, 3 ♂, 1 ♀, 1 subad. ♀ (MSB).

Vaejovis jonesi Stahnke, 1940: **U.S.A.: Arizona:** *Coconino Co.*: Wupatki National Monument: x.1938, D.J. Jones, holotype ♀ (CAS [Stahnke coll.]); Antelope Canyon, 35°33.555′N 111°22.661′W, 1454 m, 20.viii.2009, W.D. Sissom, T.G. Anton, G.S. Casper, and P. Whitefield, 1 ♂ (CAS); River Road, 35°33.881′N, 111°17.717′W, 1319 m, 9–10.viii.2007, W.D. Sissom, T.G. Anton, and G.S. Casper, sandstone outcrops and hills near Little Colorado River, 3 ♂ (AMNH

[LP 7819, 9002, 9003]); Wukoki Ruins, 35°31.772′N 111°19.710′W, 1425 m, 10.viii.2007, W.D. Sissom, T.G. Anton, G.S. Casper, and P. Whitefield, 1 ♂ (AMNH).

Vaejovis lapidicola Stahnke, 1940: **U.S.A.: Arizona:** *Coconino Co.*: Flagstaff, 17.vi.1943, 1 ♀ (MNA), 4.vi.1949, A.R. Phillips, 2 ♀ (MNA); Flagstaff, 7100 ft., vii.1947, J. Ferris, 1 ♂ (MNA); Flagstaff, red sandstone quarry, SE end Switzer Mesa, just N of junction US Route 66 and Enterprise Road, 35°11.873′N 111°37.749′W, ca. 7117 ft., 3.viii.2000, J. and C. Bigelow, Cable TV microwave station after heavy rain, 2 ♂ (AMNH [LP 1814]); Manzanita Camp, Oak Creek Canyon, 25.vii.1952, M. Cazier, W. Gertsch, and R. Schrammel, 1 ♀ (AMNH); Oak Creek Canyon, 13.5–16 mi. N Sedona, 5600–6500 ft., cracked rock wall, 10.ix.1968, M. Cazier et al., breeding pair, 1 ♂, 1 ♀ (AMNH); Oak Creek Canyon, scenic view from rim, ca. 15 mi. N Sedona, Hwy 89A, 22.viii.1995, K.L. Semones and K.J. McWest, 1 ♂, 4 ♀, 3 juv. (WDS); Oak Creek Canyon Overlook (view site), 35°01′55.2″N 111°44′01.7″W, 1969 m, 7.ix.2009, L. Prendini and J. Huff, pine forest at top of Oak Creek Canyon, exposed rock face along parking area, 2 juv. ♂ (AMNH [LP 7177]); Sedona, 6 mi. N, 11.ix.1962, V. Roth, 1 ♀ (AMNH); Sedona, 13.5–16 mi. N, 5600–6500 ft., along grade cuts, 11 ♂, 4 ♀ (AMNH), 1 ♀, 32 first instars (AMNH); Sedona, ca. 15 mi. N on US 89A, 19.viii.2009, T. Anton, Casper, and W.D. Sissom, 3 ♂, 1 ♀ (WDS); Upper Oak Creek Canyon, S of Flagstaff, 18.viii.1949, L.F. Brady, 1 ♂ (MNA).

Vaejovis paysonensis Soleglad, 1973: **U.S.A.: Arizona:** *Gila Co.*: 3.0 mi. NE Experimental Station along Globe-Young Road at intersection of Armer Mt. Road, 13.vi.1967, S.C. Williams, in pine forest with some oak, dark fine soils, 3 ♂, 9 ♀ (CAS), 2 ♂, 33 ♀, 2 subad. ♀, 4 juv. (CAS); Payson, 1.x.2007, Z.J. Valois, 1 ♀ (AMNH [LP 7822]); Star Valley, vi.2004, D. Vernier, 2 ♀ (AMNH [LP 3112]).

Vaejovis vorhiesi Stahnke, 1940: **U.S.A.: Arizona:** *Cochise Co.*: Huachuca Mts.: Carr Canyon, 7500 ft., 31.vii.1949, W.J. and J.W. Gertsch, 1 ♂, 7 ♀ (AMNH), W.J. and J.W. Gertsch, 2 ♂, 6 ♀ (AMNH); Carr Canyon, 8000 ft., 3.vi.1952, M. Cazier, W. Gertsch, and R. Schrammel, 11 ♀, 1 juv. (AMNH), 2 ♂, 8 ♀ (AMNH); Carr Canyon, 9.v.1961, W.J. Gertsch, in pines, 1 ♂ (AMNH); Carr Canyon Road, 1.1 mi. NNE Carr Peak, 7200 ft., 19.vi.1976, 2 ♀ (AMNH); Coronado National Forest, Carr Canyon, Carr Canyon Road, rocky road cut slope, 31°26.069′N 110°16.909′W, 1972 m, 21.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 2 ♂ (AMNH), 31°25.909′N 110°17.053′W, 2112 m, 21.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 2 ♂, 1 ♀ (AMNH), 31°25.946′N 110°17.052′W, 2061 m, 21.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 2 ♀ (AMNH), 31°25.812′N 110°17.208′W, 2188 m, 21.vi.2006, W. Savary and R. Mercurio, UV light detection at night, 3 ♂, 5 ♀, 2 subad. ♂, 1 juv. (AMNH), 1 ♀ (AMNH [LP 5871]); Lower Carr Canyon, 21.vii.1955, W.J. Gertsch, 1 ♀ (AMNH); Montezuma Pass, 1 mi. W, 6.ix.1950, 2 ♀ (AMNH); Montezuma Pass, 6000 ft., 4.vi.1952, M. Cazier, W. Gertsch, and R. Schrammel, 1 ♀ (AMNH); Ramsey Canyon, 10–15.vii.1941, A.B. Klots, 1 ♂ (AMNH); Sierra Vista, 7000 ft., under rocks, 17.vii.1971, G. Bawden, 3 ♀ (AMNH); Upper Carr Canyon, 22.vii.1955, W.J. Gertsch, 3 ♂, 7 ♀ (AMNH). *Pima Co*: Santa Rita Mountains: Cave Creek Canyon poss. into Florida Canyon, trail at end of Gardner Canyon Road, 1930 m, 20.vii.2008, K. Ksepka and M. Rubio, 1 ♀ (AMNH [LP 8931]). *Santa Cruz Co.*: Santa Rita Mountains: Box Canyon, 29.viii.1952, B. Malkin, 1 ♀

(AMNH); Madera Canyon, O. Bryant, 1 ♀, 1 juv. (AMNH), 19.vii.1949, W.J. Gertsch, 1 ♂, 3 ♀ (AMNH), 27.vii.1949, W.J. and J.W. Gertsch, 2 ♂, 7 ♀ (AMNH), 5 ♂, 8 ♀ (AMNH), 7 ♀ (AMNH), 7.vi.1952, M. Cazier, W. Gertsch, R. Schrammel, 8 ♀ (AMNH), 2 ♀ (AMNH), 4 ♀ (AMNH), 2 ♂, 8 ♀, 1 juv. (AMNH), 7 ♀ (AMNH), 1 ♂, 12 ♀ (AMNH), 31.vii.1952, Nutting and Warner, 1 ♀ (AMNH), 15.viii.1955, W.J. Gertsch, 1 ♂, 1 ♀ (AMNH), 19.vii.1962, W.J. Gertsch, 1 ♂, 3 ♀ (AMNH), 13.ix.1963, W.J. Gertsch, 1 ♂, 3 ♀ (AMNH); Madera Canyon, along trail to Mt. Wrightson, 21.ix.1970, R.C.A. Rice, 20 ♂, 17 ♀, 7 juv. (AMNH), 3 ♂, 3 ♀ (AMNH); Madera Canyon, Big Rock Camp, 10.ix.1941, W. Ivie, 1 ♀ (AMNH); Madera Canyon, Roundup Camp, 11.ix.1941, W. Ivie, 2 ♀, 12 juv. (AMNH), 23.iii.1960, W.J Gertsch, W. Ivie, and R. Schrammel, 12 ♀ (AMNH); Madera Canyon, upper end, 22.viii.1966, S.C. Williams, 3 ♂ (CAS); Madera Canyon, 31°42′N 110°529′W, 29.iii.2008, B. Anderson and D. Crump, 31°42.876′N 110°52.663′W, 1 ♀, 1 subad. ♀ (AMNH [LP 8336]); above Mt. Wrightson Trailhead Parking, 31°429′N 110°529′W, 5470 ft./1667 m, 25.vii.2008, H.M. Burrell and K.J. McWest, under rocks, 31°42.727′N 110°52.438′W, 2 ♀ (AMNH [LP 8860]).

ACKNOWLEDGMENTS

This research was supported by National Science Foundation grant DEB 0413453 to L.P. A grant from the Western National Parks Association to W.D.S. facilitated the collection of additional comparative material of *V. jonesi*. Charles E. Griswold (CAS), G.B. Edwards (FSCA), Barney Tomberlin (who forwarded the Martin Muma material of *V. feti* to W.D.S.), and Joe L. Bigelow kindly loaned us specimens. We thank Diane Chung, Gwen Gallenstein, Bob Van Belle, and Paul Whitefield of the National Park Service and Wupatki National Monument for granting the permit to collect in Wupatki National Monument and to the National Forest Service office, Stafford, Arizona, for granting permits to collect in National Forests. We also thank Tom G. Anton, Joe L. Bigelow, Michelle Capes, Gary S. Casper, Brent Hendrixson, Jeremy Huff, Chuck Kristensen, Kari J. McWest, Randy J. Mercurio, Manny Rubio, Warren E. Savary, Zach J. Valois, Darrin Vernier, Rick C. West, and Paul Whitefield for collecting specimens or assisting us in the field; Richard F. Ayrey for information on the Getz Peak locality; Steve Thurston for assistance with preparing the plates; and Oscar F. Francke and Matt R. Graham for comments on a previous version of the manuscript.

REFERENCES

Arizona State Land Department. 1993. Native vegetation of Arizona. Phoenix: Arizona Land Resources Information System.

Ayrey, R.F., and M.E. Soleglad. 2011. A new species of *Vaejovis* from Prescott, Arizona (Scorpiones: Vaejovidae). Euscorpius 114: 1–17.

Graham, M., and R.W. Bryson, Jr. 2010. *Vaejovis montanus* (Scorpiones: Vaejovidae), a new species from the Sierra Madre Occidental of Mexico. Journal of Arachnology 38: 285–293.

Haradon, R.M. 1984. New and redefined species belonging to the *Paruroctonus borregoensis* group (Scorpiones, Vaejovidae). Journal of Arachnology 12: 317–339.

Hjelle, J.T. 1990. Anatomy and morphology. *In* G.A. Polis (editor), The biology of scorpions: 9–63. Stanford, CA: Stanford University Press.

Hughes, G.B. 2011. Morphological analysis of montane scorpions of the genus *Vaejovis* (Scorpiones: Vaejovidae) in Arizona with revised diagnoses and description of a new species. Journal of Arachnology 39: 420–438.

McWest, K.J. 2009. Tarsal spinules and setae of vaejovid scorpions (Scorpiones: Vaejovidae). Zootaxa 2001: 1–126.

Santibañez-Lopez, C., and W.D. Sissom. 2010. A new species of the *Vaejovis eusthenura* group in Oaxaca, Mexico. Zootaxa 2493: 49–58.

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

Stahnke, H.L. 1940. The scorpions of Arizona. Iowa State College Journal of Science 15: 101–103.

Vachon, M. 1974 [1973]. 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. Zoologie (3) 140: 857–958.

Complete lists of all issues of *Novitates* and *Bulletin* are available on the web (http://digitallibrary.amnh.org/dspace). Order printed copies on the web from http://www.amnhshop.com or via standard mail from:

American Museum of Natural History—Scientific Publications
Central Park West at 79th Street
New York, NY 10024

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (permanence of paper).