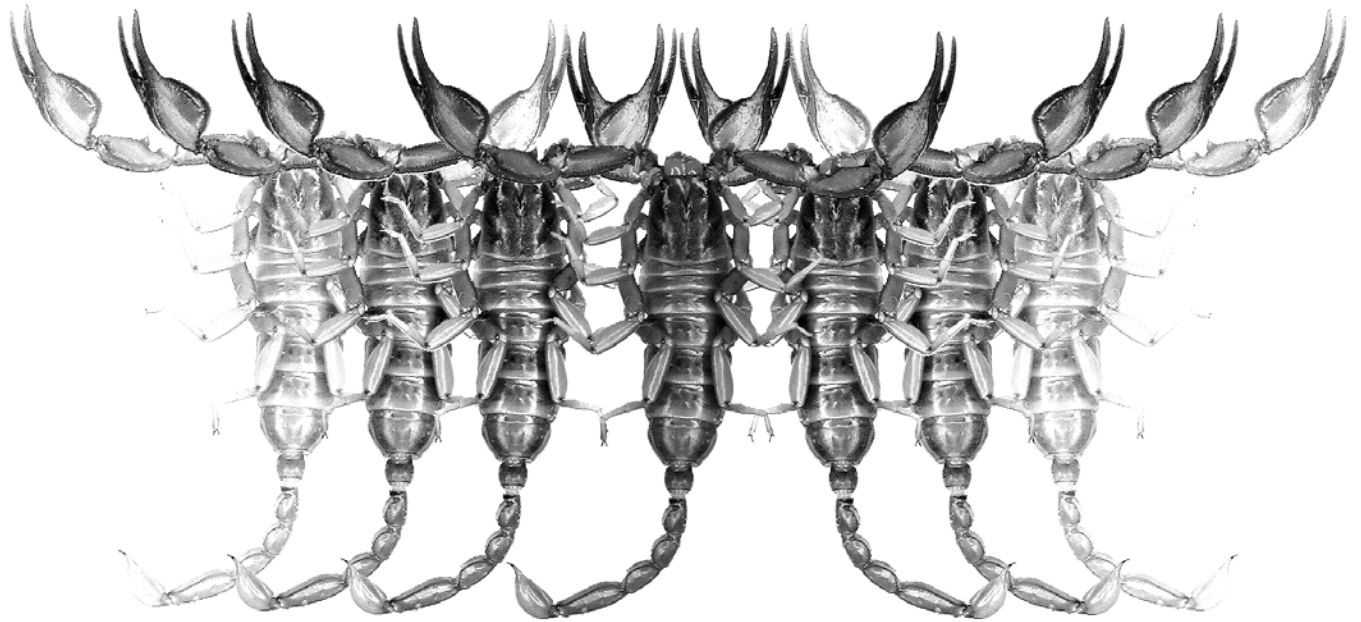


Euscorpium

Occasional Publications in Scorpiology



**Sky Island *Vaejovis*: Two New Species and a Redescription
of *V. vorhiesi* Stahnke (Scorpiones: Vaejoidea)**

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Sky island *Vaejovis*: two new species and a redescription of *V. vorhiesi* Stahnke (Scorpiones: Vaejovidae)

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Summary

Two new scorpion species, *Vaejovis cashi* sp. nov. and *V. feti* sp. nov. are described and placed in the “mexicanus” group of the genus *Vaejovis*. These small scorpions were collected at high-elevations from the sky island archipelago of southern Arizona and New Mexico. Both new species are similar to *V. vorhiesi* Stahnke, a small mesic scorpion of the Huachuca and Santa Catalina Mountains. The original description of *V. vorhiesi* consists of a single uninformative paragraph and a holotype was never designated. This paper provides a redescription and lectotype designation for *V. vorhiesi* and describes the two new related species. All three species are illustrated and compared to closely related members of the *Vaejovis* “mexicanus” group; *V. jonesi* Stahnke, *V. paysonensis* Soleglad, and *V. lapidicola* Stahnke.

Introduction

The topography of southern Arizona and New Mexico consists of low-laying desert and grassland interspersed with high-elevation (1,496–3,267 m a.s.l.) mountain ranges (Masta, 2000). Colloquially, the mountain ranges are referred to as “sky islands,” since they literally form an archipelago of mesic mountain habitats in the sky (Dyer & Jaenike, 2005). These insular mountain tops contain the most northern extent of Madrean evergreen forests and provide a cool refugium for many species (Brown, 1982; Brown & Lowe, 1980; Masta, 2000; Schmidt & Jacobson, 2005). Faunas adapted to these isolated mountain environments are therefore disconnected from similar habitat on adjacent mountain ranges by extreme climates of xeric lowlands. Gene flow is thus highly restricted (Burt, 2006; DeBano et al., 1995), so it is not surprising that many species show phenotypic variation between the various “sky island” ranges, making southern Arizona and New Mexico hotspots for biodiversity.

In a three-page abstract of his doctoral work, Stahnke (1940) described a scorpion species endemic to the mesic habitats of two of these sky islands. The small brown scorpion, *Vaejovis vorhiesi* Stahnke, inhabits mountainous slopes above 2,000 m in elevation, where it has been found under stones among pine and oak litter (Sissom, 2000). It is part of the *Vaejovis* “mexicanus” group of scorpions, a heterogeneous mix comprised mostly of small mountain species that prefer similar

habitat. The original description of *V. vorhiesi* consists only of the following single paragraph:

“*Vaejovis vorhiesi*. Foundation color yellowish-brown variegated with dark brown and black. Trunk marbled above but not below. Each tergum coarsely granulated, especially the posterior half. Two more or less yellowish-brown, smooth to finely granular, V-shaped marks, with apex directed medially, found laterad on the second to sixth terga. Fifth caudal segment hardly twice as long as wide. Intercarinal spaces on this segment coarsely granular and variegated with black and brown. Carapace longer than fifth caudal segment. Sixt [*sic*] to eight subcircular middle lamellae in pectines. The specimens were taken in Huachuca Mts., Santa Catalina Mts., and Tucson.”

Nine species total are described in Stahnke’s abstract, which completely lacks illustrations, doesn’t designate holotypes, and is of little help in identifying specimens. The nine species are thus sometimes referred to as the “Stahnke inscrutables” (Graham, 2006; Soleglad & Fet, 2006).

After examining sky island scorpion specimens, similar to *V. vorhiesi*, but from ranges further to the east, it was evident that they actually represent two new species. Both are members of the “mexicanus” group and were found in analogous habitat at high elevations. *V. cashi* sp. nov. was discovered 113 km northeast of the type locality for *V. vorhiesi*, at an elevation of 2,515 m in

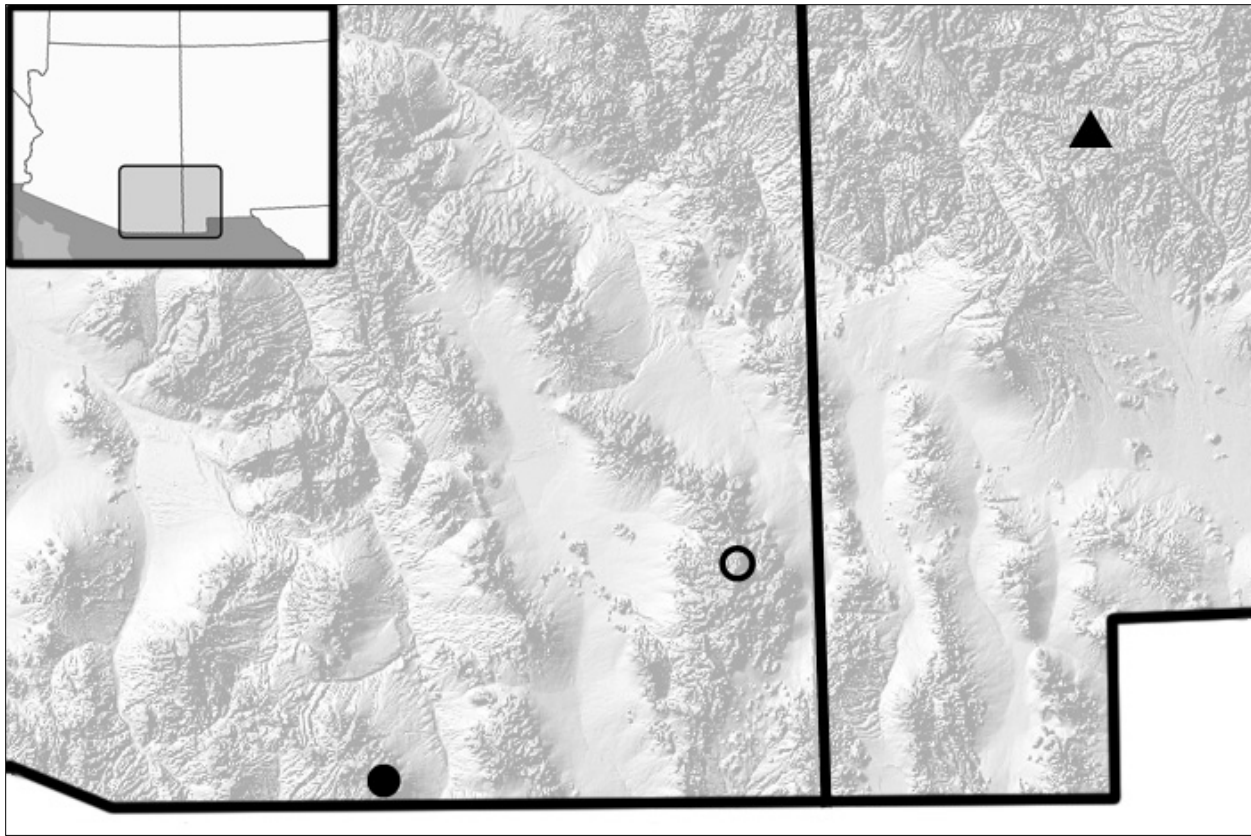


Figure 1: Relief map displaying type localities of three sky island *Vaejovis* in Arizona and New Mexico. Solid circle indicates *V. vorhiesi* Stahnke, open circle indicates *V. cashi* sp. nov., and triangle represents *V. feti* sp. nov.

the Chiricahua Mountains of Arizona. Another 160 km further northeast, *V. feti* sp. nov. was discovered at Meadow Creek in the Black Mountains of New Mexico (Fig. 1).

The two new species and *V. vorhiesi* are small, dark, and mottled scorpions which possess many similar characters. Based on criteria outlined by Soleglad (1973) it is obvious that they are closely related members of the “mexicanus” group. The three species could have shared a common ancestor that once inhabited a large range across the sky island region but speciated allopatrically due to vicariance events. Scorpions typically have small home ranges (Polis, 1990; Polis et al., 1985) and relatively low dispersal capabilities, so those that are adapted to mesic habitats would be especially susceptible to climate induced fragmentation. Based on substratum specialization, or the dependence on substrata of specific hardness, texture or composition for survival (Prendini, 2001), many species are often restricted to or more abundant in areas of specific edaphic conditions (Bradley, 1986; Lamoral, 1979; Lawrence, 1969; Polis, 1990). Odds are that sky island *Vaejovis* adapted to mesic Madrean forest soils would have trouble traversing the sandy substrata of the adjacent low-laying deserts. In addition, predation and competition by psammophiles of low-laying deserts

would further impede dispersal to neighboring mountain ranges. Sandy habitats tend to promote dominance by a single psammophilic species; the result of highly specialized sand adaptations, or of large and aggressive psammophiles that prevent small species from occupying habitat (Polis, 1990). In consequence, it is even more unlikely that the tiny sky island *Vaejovis* could traverse the desert floors.

Fragmentation of the Madrean forests is conceived to be the result of climatic oscillations. It is thought that repeated glaciation events forced sky island woodlands through cycles of fragmentation and reconnection (Masta, 2002). Thus, during periods of fragmentation, lower elevations became cactus- and legume-dominated desert scrub and the cool climate habitats fragmented into insular mountain-top refugia (Smith & Farrell, 2005; Thompson & Anderson, 2000). The isolated populations were then subjected to chance effects and drift, different selective pressures, and unique accumulations of mutations; which in some cases caused allopatric speciation. Reconnection events, on the other hand, would have increased gene flow and caused introgression or hybridization. With this in mind, scorpions on adjacent ranges separated by high desert or grassland, lack the extreme barriers of low elevation, and probably introgressed more recently making them

more closely related. On the other hand, scorpions inhabiting ranges flanking areas of low desert must have been isolated much longer, thus given time to speciate.

The three *Vaejovis* species of Arizona and New Mexico sky islands, all inhabit ranges which are bifurcated by extreme low-laying desert. Considering that the earth's temperatures are continuing to rise, the Madrean forests of the southwestern sky islands will continue to move upslope, even further isolating these species and maintaining their separate evolutionary trajectories.

Presented herein is a description of three sky island scorpion species. The "Stahnke inscrutable" *V. vorhiesi* is illustrated and described and a lectotype for the species is finally designated. The two new related species, *V. cashi* **sp. nov.** and *V. feti* **sp. nov.**, are also described, illustrated, and compared to *V. jonesi* Stahnke, *V. lapidicola* Stahnke, *V. paysonensis* Soleglad, and *V. vorhiesi*. Hopefully these small montane scorpions will no longer be so 'inscrutable.'

Material and Methods

Measurements are as described by Stahnke (1970), trichobothrial patterns are as in Vachon (1974), and pedipalp finger dentition follows Soleglad & Sissom (2001). Some descriptions of *V. vorhiesi*, especially color, are modified from the original description by Stahnke (1939). Laterobasal Aculear Serrations (LAS) denticles are after Fet et al. (2006).

Abbreviations

List of depositories: CAS, California Academy of Sciences, San Francisco, California, USA; MES, Personal collection of Michael E. Soleglad, Borrego Springs, California, USA; MRG, Personal collection of Matthew R. Graham, Huntington, West Virginia, USA.

Material examined (other than types)

Parvorder Iurida, superfamily Chactoidea, family Vaejovidae: *Vaejovis feti* **sp. nov.**, 7 ♂ and 5 ♀, Meadow Creek, Grant County, New Mexico, USA (type locality), 6 July 1978 (Martin Muma) [MES]; *Vaejovis lapidicola* Stahnke, 1940, ♂ lectotype and ♀ paralectotype, 1 mi. E. of Flagstaff in a red sandstone quarry, Coconino County, Arizona, USA, 6 August 1938 (H.L. Stahnke) [CAS #15172]; *Vaejovis paysonensis* Soleglad, 1973, ♀, Payson, Gila County, Arizona, USA (type locality), 2001 (D. Vernier) [MRG]; *Vaejovis vorhiesi* Stahnke, 1940, 2 ♂ and 8 ♀, Miller's Canyon, Huachuca Mountains, Cochise County, Arizona, USA (type locality), 23 July 1958 (M. Soleglad, D. Douglass) [MES].

Systematics

Vaejovis vorhiesi Stahnke, 1940

(Figs. 2–14)

Diagnosis. *Vaejovis vorhiesi* is a small yellowish-brown to dark brown scorpion with darker mottling on the carapace, legs, tergites, and metasoma. The anterior margin of carapace slightly emarginate and carapace and tergites are smooth to finely granular. Stahnke (1940) incorrectly stated that the carapace is longer than the fifth metasomal segment. The carapace length is actually about equivalent to and can even be less than the length of the fifth metasomal segment.

V. vorhiesi can be distinguished from the related species *V. cashi* **sp. nov.** and *V. feti* **sp. nov.** by the following: larger in size; pattern less fuscous on carapace, metasoma, pedipalps, tergites and legs; weaker crenulation on metasoma, mesosoma, pedipalps, tergites and legs; 6–7 median denticles (MD) on denticle row 3 of the movable finger, instead of 8–9 MD denticles; known from the Huachuca Mountains, Santa Catalina Mountains, and Tucson, Arizona (*V. cashi* **sp. nov.** known only from the Chiricahua Mountains, Arizona; *V. feti* **sp. nov.** only from the Black Mountains of New Mexico) (Fig. 1). *V. vorhiesi* is also unique in morphometric ratios and pectine counts (see Comparison of Species).

Type Data. Lectotype (designated here): female, Miller's Canyon, Huachuca Mountains, Cochise County, Arizona, USA, 10 October 1938 (H.L. Stahnke) specimen #291, CAS No. 15172 [metasoma detached at segment II]. Paralectotype: male, Santa Catalina Mountains, Pima County, Arizona, USA, date unknown (H.L. Stahnke) specimen #296, CAS No. 15172 [heavily damaged].

Etymology. This species was named in honor of Charles T. Vorhies, Professor Emeritus of the Department of Entomology at the University of Arizona.

Distribution. Known from the type locality, Miller's Canyon of the Huachuca Mountains of Cochise County, from the Santa Catalina Mountains of Pima County, and from Tucson, Arizona, USA.

Redescription based on lectotype

Color (Figs. 2–3). Carapace, tergites, legs, and metasoma with dark brown to black variegations dorsally. Ocular tubercle surrounded by a yellow to brown diamond-shaped region which is flanked by four elongate lighter patches. Remainder of carapace variegated with dark brown and lateral yellowish-brown areas. Yellowish-brown V-shaped marks found laterally on tergites II–VI.

Measurements (in mm). Lectotype: total length 24.28; carapace length 3.36; mesosoma length 10.00;



Figures 2–3: *Vaejovis vorhiesi* Stahnke, 1940 lectotype. 2. Dorsal view. 3. Ventral view.

metasoma length 10.92; Metasoma: segment I length/width 1.53/1.91; segment II length/width 1.67/1.81; segment III length/width 1.79/1.76; segment IV length/width 2.52/1.65; segment V length/width 3.41/1.53. Telson: length 3.03; vesicle length/width/depth 1.95/1.06/0.89; aculeus length 1.08. Pedipalps: total length 10.73; femur length/width 2.82/0.92; patella length/width 2.99/1.06; chela length 4.92; palm length/width/depth 2.00/1.18/1.18; movable finger length 3.08; fixed finger length 2.54.

Carapace (Fig. 11). Anterior margin of carapace slightly emarginate, with three lateral eyes found on each side. Median furrow moderate and traverses entire length of carapace, including the median eyes. Carapace finely granular with scattered coarse granules. Ratio of median eyes location (from anterior edge)/carapace length 0.34; carapace length/width at median eyes 2.95. V. Entire carapace dorsolaterally convex, especially the posterior half. Carapace longer than pedipalp movable finger but slightly shorter than metasomal segment.

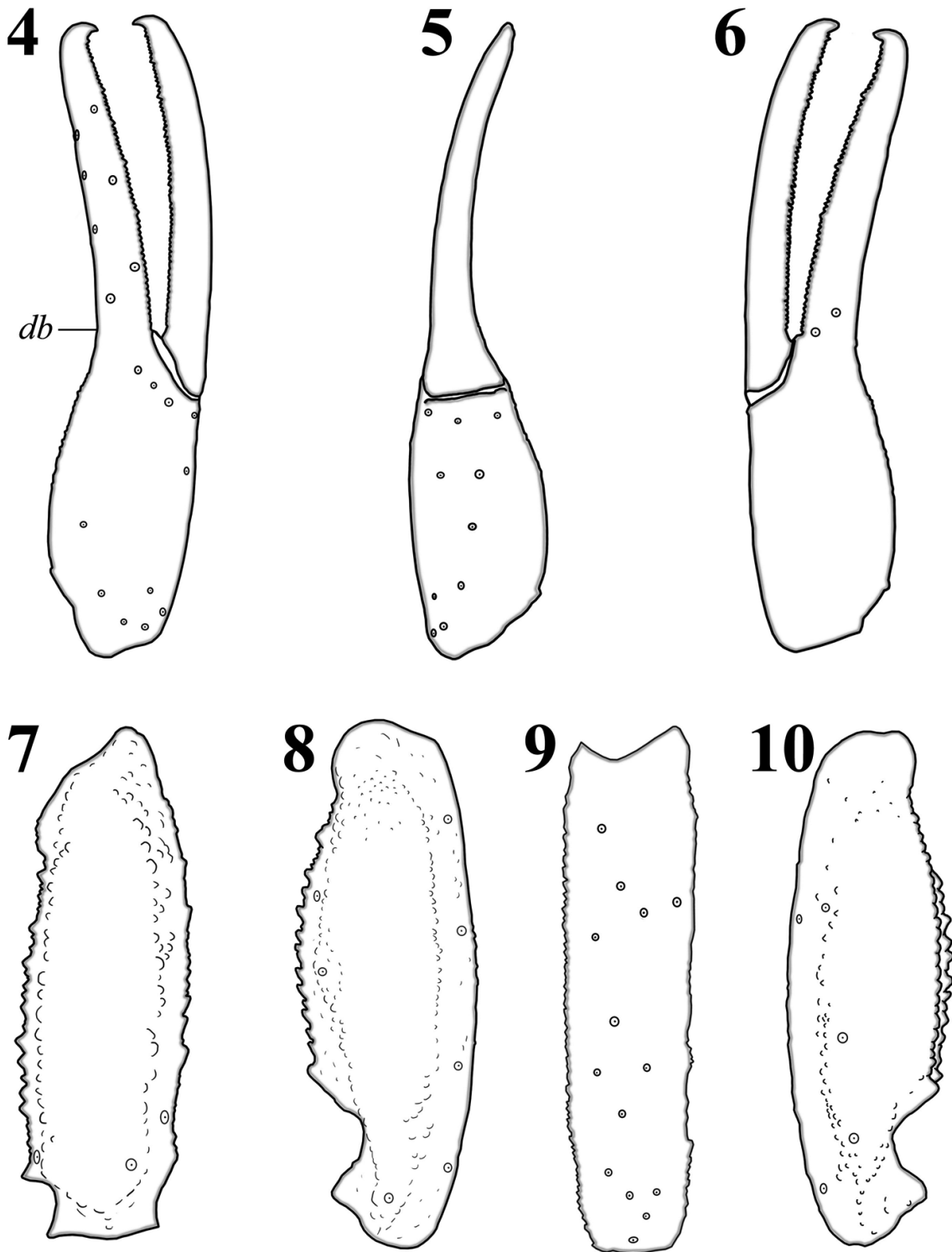
Mesosoma. Tergites coarsely granular with weak median carinae on I–VI. Tergite VII with weak median carina on anterior half and strong dorsal lateral and lateral suprmedian granular carinae. Pretergites smooth to finely granular. Sternites III–VI smooth and without carinae. Sternite VII with granular ventral lateral carinae on posterior one-fifth to posterior three-fifths. Pre-sternites smooth. Spiracles ovoid with median side

rotated 35° away from posterior sternite margin. Posterior margin of sternites bearing variable numbers of microsetae.

Genital Operculum. Sclerites separated on posterior one-fifth.

Pectines (Fig. 14). Pectinal tooth count 13/13. Middle lamellae 7/7 (note that Stahnke originally miscounted 6/7 middle lamellae for this specimen).

Metasoma. Ratio of segment I length/width 0.80; of segment II length/width 0.92; of segment III length/width 1.02; of segment IV length/width 1.53; of segment V length/width 2.23. Segments I–IV: dorso-lateral carinae strong and granular with distal denticle of II–IV enlarged and spinoid; of segment I only slightly enlarged and spinoid. Lateral suprmedian carinae I–III strong and granular with enlarged spinoid distal denticle; on IV strong and granular on anterior 1/2 and weak on posterior 1/2 with terminus flared. Lateral infrmedian carinae moderately granular on segment I, posterior 2/5 of II, 1/5 of III, and obsolete on IV. Ventrolateral carinae I weak and granular; on II–III moderate, granular; on IV strong, granular. Ventral submedian carinae granular. Dorsal and lateral intercarinal spaces very finely granular. Segment I–IV ventral submedian setae 3/3:3/3:3/3:3/3. Segment V: Dorsolateral carinae moderate, distally crenulate, basally granular. Lateromedian carinae moderate and granular on basal 3/4, obsolete on distal 1/4. Ventrolateral and ventromedian carinae

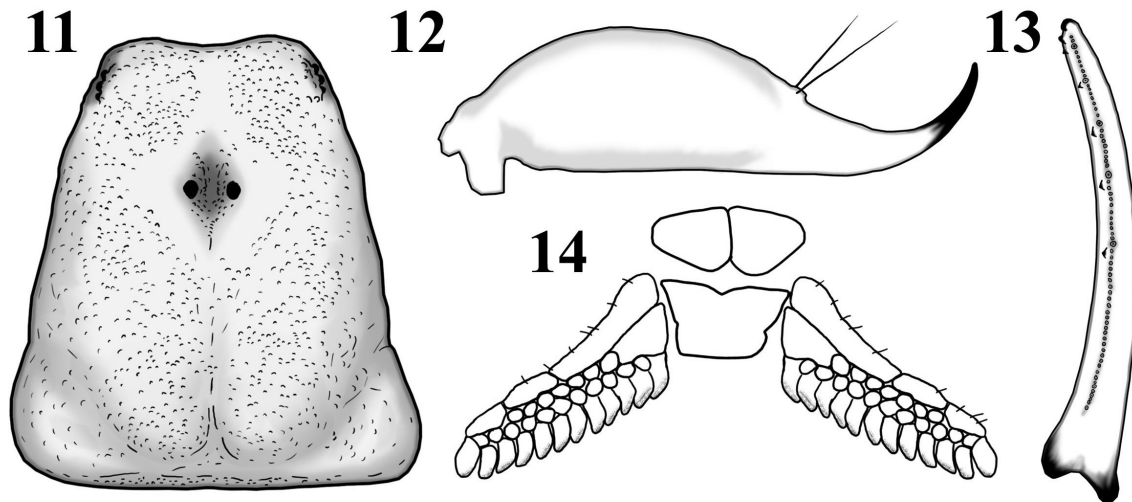


Figures 4–10: Trichobothrial patterns of *Vaejovis vorhiesi* Stahnke, based on lectotype. **4.** Right pedipalp chela, external. **5.** Right pedipalp chela, ventral. **6.** Right pedipalp chela, internal. **7.** Right pedipalp femur, dorsal. **8.** Right pedipalp patella, dorsal. **9.** Right pedipalp patella, external. **10.** Right pedipalp patella, ventral.

strong, crenulate. Intercarinal spaces finely granular. uous subaculear tubercule. LAS denticles 4/4.
Segment V ventrolateral setae 5/5.

Telson (Fig. 12). Smooth with small but conspic-

Chelicerae. Dorsal edge of movable cheliceral
finger with two subdistal (*sd*) denticles; ventral edge



Figures 11–14: *Vaejovis vorhiesi* Stahnke. **11.** Carapace, dorsal view (mottling not illustrated). **12.** Telson, lateral view. **13.** Pedipalp chelal finger dentition, right movable finger. **14.** Pectines and genital operculum of female.

smooth to crenulate with conspicuous serrula on distal half.

Pedipalps. Trichobothrial pattern type C (see pattern in Figs. 4–10). Pedipalpal ratios: chela length/width 4.17; femur length/width 3.07; patella length/width 2.82; fixed finger length/carapace length 0.76.

Chela. All carinae weak and smooth except for a few weak to moderate granules on the inner surface of palm. Median (MD) denticles of fixed finger aligned and divided into six subrows by five outer (OD) denticles; flanked by five inner (ID) denticles. Movable finger (Fig. 13) with six subrows, five OD denticles and six ID denticles. Movable finger shorter than both the carapace and metasomal segment V.

Femur. Carinae strong, granulose; internal surface with large scattered granules that almost form a carina on the middle three fourths.

Patella. Internal carinae oblique and granulose; all other carinae strong and crenulate.

Legs. Ventral surface of tarsus with single median row of spinules terminating distally with one spinule pair.

Remarks. There are four specimens of this species listed in Stahnke's doctoral dissertation (Stahnke, 1939), but only two are found in Stahnke's collection (CAS). These two specimens were listed as syntypes by Sissom (2000: 544). The second type series specimen (CAS 15172), which becomes a paralectotype with lectotype designation, is a male labeled #296, and is in such bad condition that it was not used for this study. The dissertation, however, does state the following about the specimen: carapace length 3.2; cauda length 12; telson length 3.0; total length 26.0, pectinal tooth count 13/13; middle lamellae 7/7. The specimen was collected from the Santa Catalina Mountains of Pima County, Arizona, by Stahnke at an unknown date. Based on a contiguous

series of high altitude ridgelines, with lowest points over 1,200 m in elevation, the Santa Catalina scorpions are probably disjunct populations of *V. vorhiesi* and not another species. On the other hand, it is hard to say how long the populations have been isolated and the Santa Catalina Mountains scorpions definitely warrant further study if specimens become available.

Stahnke (1939) also reports a specimen from Tucson. It is unknown where exactly that Stahnke collected the specimen in Tucson, or at what elevation, so it is hard to speculate about what species it is until it becomes available for study.

Vaejovis cashi Graham, sp. nov.

(Figs. 15–27)

Diagnosis. This small brownish colored scorpion is heavily mottled on the carapace, legs, tergites, and metasoma. The anterior margin is weakly emarginate. A subaculear tubercule can be conspicuous to almost lacking. This species is a related species of *V. vorhiesi* and *V. feti* sp. nov. It can be distinguished from *V. vorhiesi* by its smaller size, stronger crenulations, more fuscous mottling, and 8–9 MD denticles on row 3 of the movable pedipalp finger, instead of 6–7 MD denticles. It is unique from *V. feti* sp. nov. by being brownish in color, not reddish brown or mahogany, and has less robust metasoma and pedipalp palms. *V. cashi* sp. nov. is also unique in morphometrics ratios and pectine counts (see Comparison of Species).

Type Data. The holotype and paratype, both female, were collected from under stones on the northwest flank of the Chiricahua Mountains, Arizona; 31°55'24.36"N, 109°15'42.34"W; 18 June 2001 (D. Vernier), types deposited in the private collection of MRG.



Figures 15–16: *Vaejovis cashi* sp. nov., holotype. 15. Dorsal view. 16. Ventral view.

Etymology. The specific name, *cashii*, is an epithet in honor of Kevin Cash, a passionate scorpion enthusiast who has made gracious contributions to scorpiology.

Distribution. Known only from the type locality in the Chiricahua Mountains of Arizona, USA.

Description

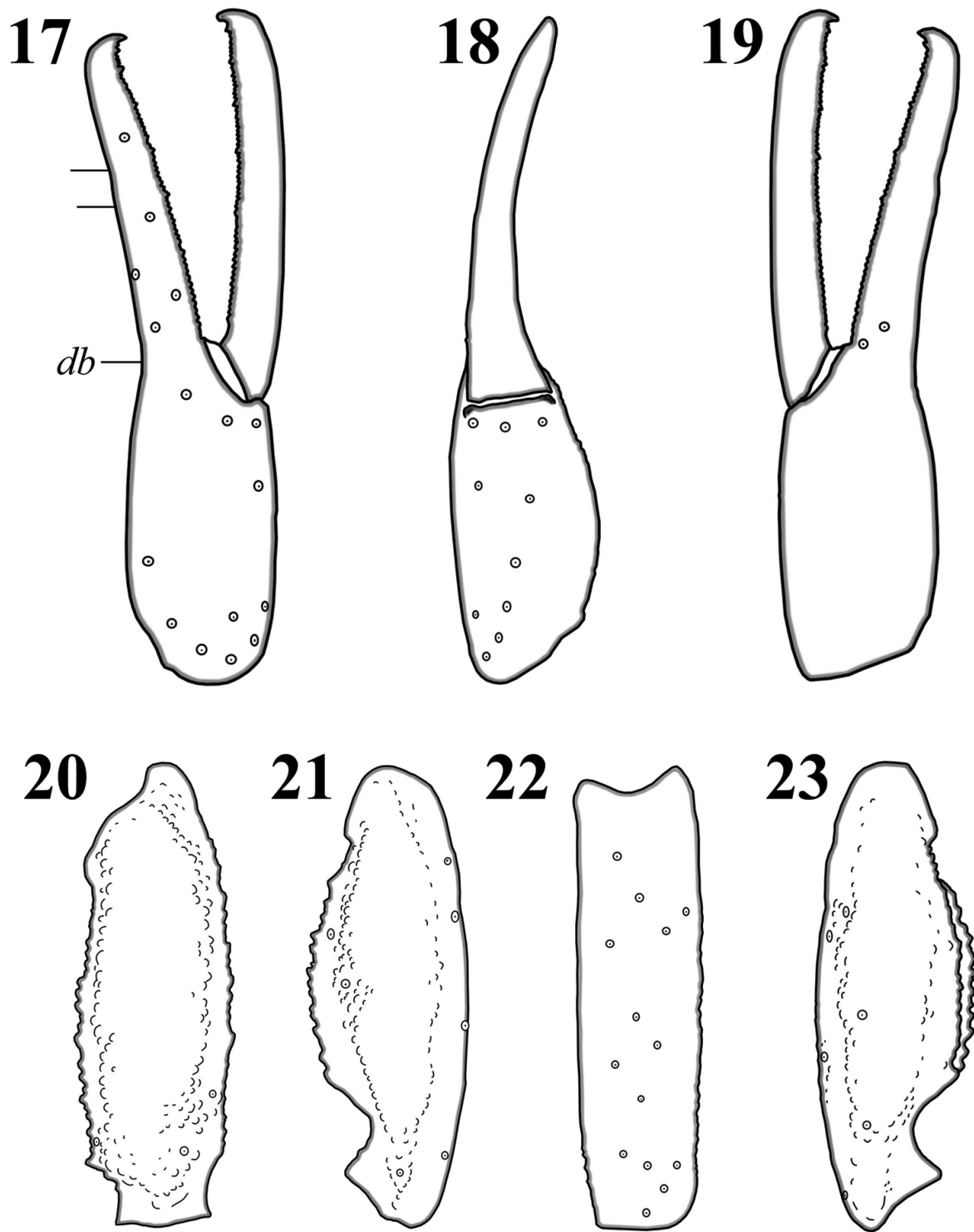
Color (Figs. 15-16). Carapace and tergites yellow-brown with dark dusky patterns. Two stripes of fuscidity running laterally along tergites. Dark-brown to black median eye area. Metasoma yellow-brown with fuscidity of dusky markings increasing posteriorly. Telson yellow-orange with three brown stripes running longitudinally along ventral surface. One median stripe and two dorsolateral stripes. Subaculear tubercle small and black. Legs yellow-orange with slight mottling.

Measurements (in mm). *Holotype*: total length 21.96; carapace length 2.96; mesosoma length 8.18; metasoma length 8.09; Metasoma: segment I length/width 1.20/1.67; segment II length/width 1.34/1.62;

segment III length/width 1.44/1.53; segment IV length/width 2.05/1.51; segment V length/width 2.96/1.44. Telson: length 2.73; vesicle length/width/depth 1.65/0.96/0.75; aculeus length 1.08. Pedipalps: total length 9.30; femur length width 2.45/0.80; patella length/width 2.52/0.89; chela length 4.33; palm length/width/depth 1.88/1.01/1.04; movable finger length 2.52; fixed finger length 2.09.

Paratype (female): total length 19.09; carapace length 2.68; mesosoma length 6.12; metasoma length 10.29; Metasoma: segment I length/width 1.03/1.48; segment II length/width 1.20/1.44; segment III length/width 1.27/1.34; segment IV length/width 1.78/1.29; segment V length/width 2.66/1.22. Telson: length 2.35; vesicle length/width/depth 1.41/0.89/0.71; aculeus length 0.82. Pedipalps: total length 8.02; femur length/width 2.07/0.71; patella length/width 2.33/0.82; chela length 3.62; palm length/width/depth 1.55/0.85/0.92; movable finger length 2.26; fixed finger length 1.79.

Carapace (Fig. 24). Anterior margin of carapace very slightly emarginate. Carapace finely granular with



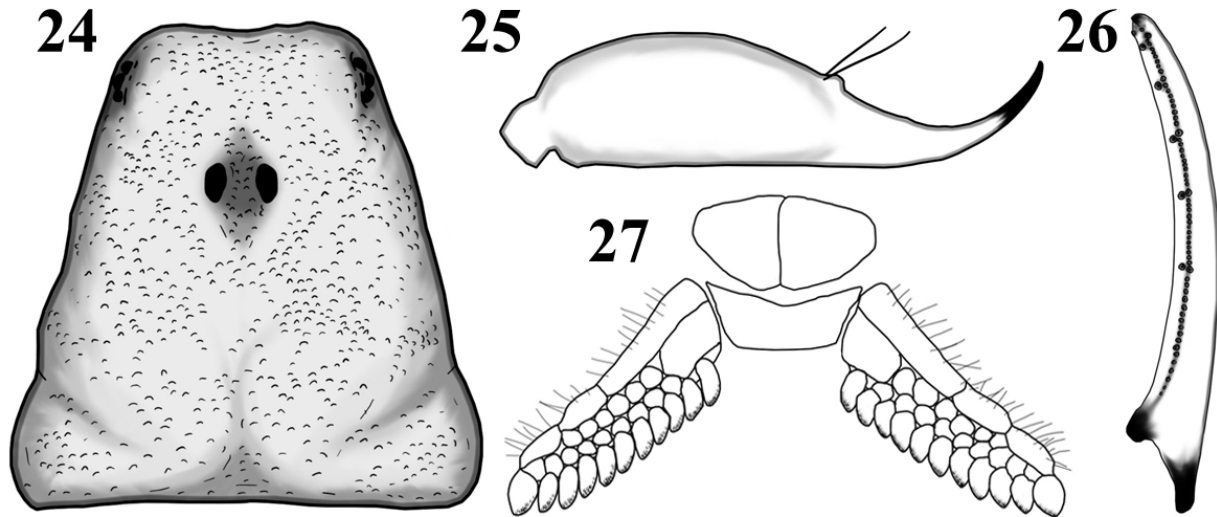
Figures 17–23: Trichobothrial patterns of *Vaejovis cashi* sp. nov., based on holotype. **17.** Right pedipalp chela, external. **18.** Right pedipalp chela, ventral. **19.** Right pedipalp chela, internal. **20.** Right pedipalp femur, dorsal. **21.** Right pedipalp patella, dorsal. **22.** Right pedipalp patella, external. **23.** Right pedipalp patella, ventral.

scattered coarse granules and a shallow posterior median furrow.

Mesosoma. Median carina on tergite I obsolete, very slight on tergite II–III, and weak on IV–VI. Tergite

VII with weak to moderate median carina and strong crenulate lateral carina.

Genital Operculum. Sclerites separated on posterior one-fifth.



Figures 24–27: *Vaejovis cashi*, **sp. nov.**, based on holotype. **24.** Carapace, dorsal view (mottling not illustrated). **25.** Telson, lateral view. **26.** Pedipalp chelal finger dentition, right movable finger. **27.** Pectines and genital operculum of female.

Chelicerae. Dorsal edge of movable with two subdistal (*sd*) denticles; ventral edge smooth with conspicuous serrulae on distal half.

Pectines (Fig. 27). Pectinal tooth count 11/11. Sternites III–VII sparsely setose. Sternite VII with a pair of weak granular carinations.

Metasoma. Ratio of segment I length/width 0.82; of segment II length/width 0.98; of segment III length/width 1.07; of segment IV length/width 1.52; of segment V length/width 2.14. Segments I–IV: dorsolateral carinae strong and granular with distal denticle of II–IV enlarged and spinoid; of segment I slightly enlarged and spinoid. Lateral suprmedian carinae I–III strong and granular with enlarged spinoid distal denticle; on IV strong and granular on anterior 1/2 and weak on posterior 1/2, with terminus flared. Lateral inframedian carinae moderately granular on segment I, posterior 2/5 of II, 1/5 of III, and obsolete on IV. Ventrolateral carinae I weak, finely granular; on II–III moderate, granular; on IV–V strong, granular. Ventral submedian carinae granular. Dorsal and lateral intercarinal spaces very finely granular. Segment I–IV setal count: dorsolateral setae 0/0:0/1:0/1:1/1; lateral suprmedian setae 0/0:0/0:0/0:2/1; Lateral inframedian setae 1/1:0/0:0/0:0/0; Ventrolateral setae 2/2:2/2:3/2:3/3; Ventral submedian setae 3/3:3/3:3/3:3/3. Segment V: Dorsolateral carinae moderate, distally crenulate, basally granular. Lateromedian carinae moderate and granular on basal 3/4, obsolete on distal 1/4. Ventrolateral and ventro-median carinae strong, crenulate. Intercarinal spaces finely granular. Segment V setal counts: Dorsolateral setae 3/3; lateromedian setae 3/4; ventrolateral setae 5/5.

Telson (Fig. 25). Smooth with small but conspicuous subaculear tubercle. Five pairs of large setae and many smaller scattered setae. LAS denticles 6/7.

Pedipalps. Trichobothrial pattern type C (see pattern in Figs. 17–23). Pedipalpal ratios: chela length/width 4.99; femur length/width 3.06; patella length/width 2.82; fixed finger length/carapace length 0.73.

Chela. All carinae weak and smooth except dorsolateral, which is slightly crenulate. All vestigial carinae outlined with dark fuscidity. Fixed fingers: Dentate margin with six subrows of MD denticles divided by five enlarged OD denticles; five ID denticles. Movable fingers (Fig. 26): Dentate margin with six subrows of MD denticles divided by five enlarged OD denticles; six ID denticles. No distinct scalloping on chela fingers.

Femur. Carinae strong, granulose; internal surface with moderate carinae on proximal 2/3.

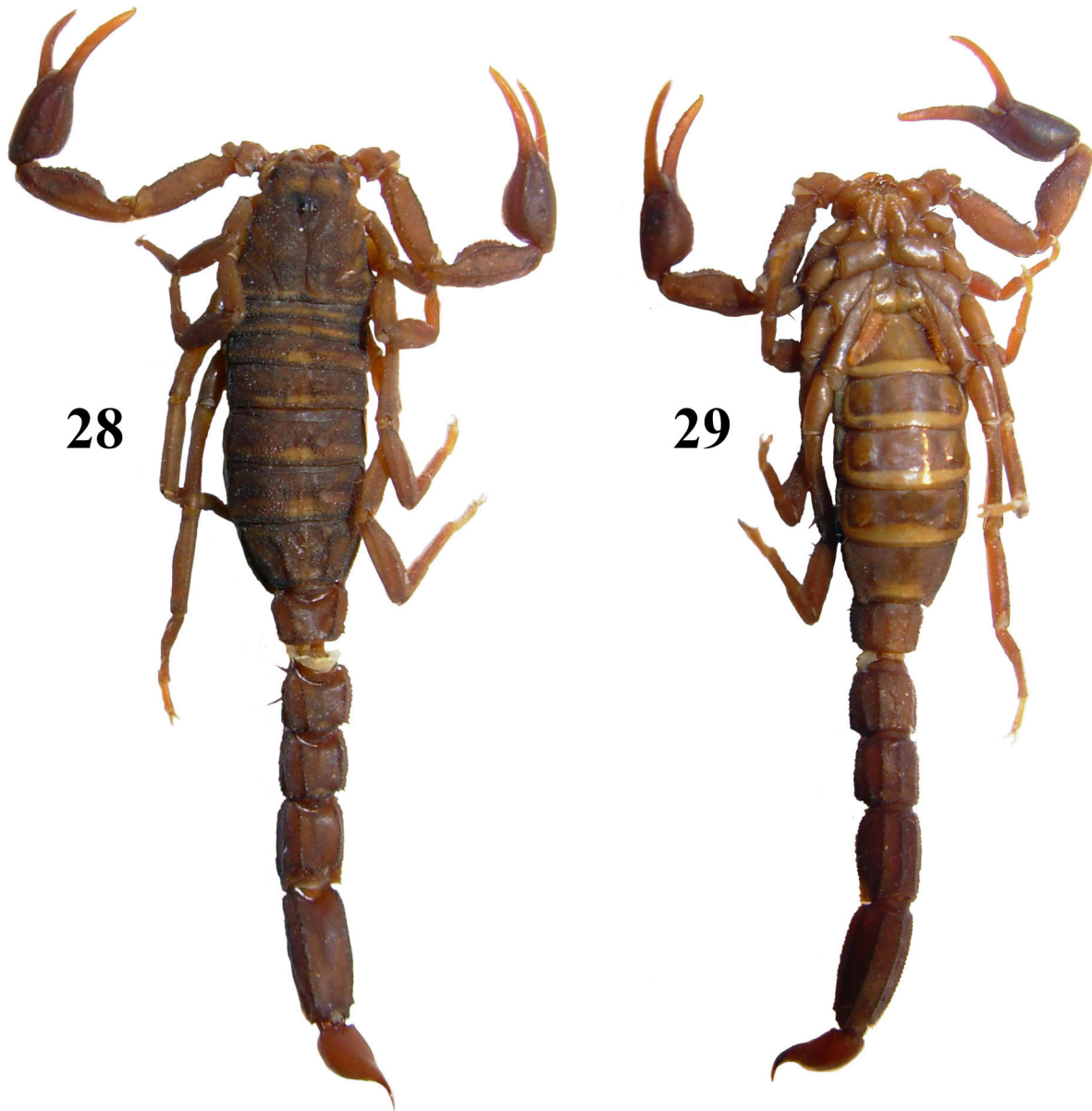
Patella. Internal carinae oblique and granulose; all other carinae strong and crenulate.

Legs. Ventral surface of tarsus with single median row of spinules terminating distally with one spinule pair.

Variation. Only two female specimens were available for examination. The specimens vary only in size and telson shape. The paratype is slightly smaller with telson ratios as follows: telson length/width ratio 1.73; telson length/depth ratio 1.93. Holotype telson ratios are: telson length/width ratio 1.81; telson length/depth ratio 2.37.

***Vaejovis feti* Graham, **sp. nov.**
(Figs. 28–39)**

Diagnosis. *Vaejovis feti* **sp. nov.** is the smallest of the sky island species. It differs from the other two, *V. vorhiesi* and *V. cashi* **sp. nov.**, by being more reddish



Figures 28–29: *Vaejovis feti* sp. nov., holotype, dorsal and ventral views.

brown in color and possessing more robust pedipalp palms and metasoma. More specifically it differs from *V. vorhiesi* by possessing 8–9 MD denticles on row 3 of the movable pedipalp finger, instead of 6–7 ID denticles. This species completely lacks a subaculear tubercles, unlike *V. cashi* sp. nov. which has a small to moderately sized subaculear tubercle. *V. feti* sp. nov. is also unique in morphometrics ratios and pectine counts (see Comparison of Species).

Type Data. The female holotype and male paratype were collected from Meadow Creek, New Mexico, USA, 6 July 1978 (Martin Muma), deposited in the private collection of MES.

Etymology. This scorpion is named after my college

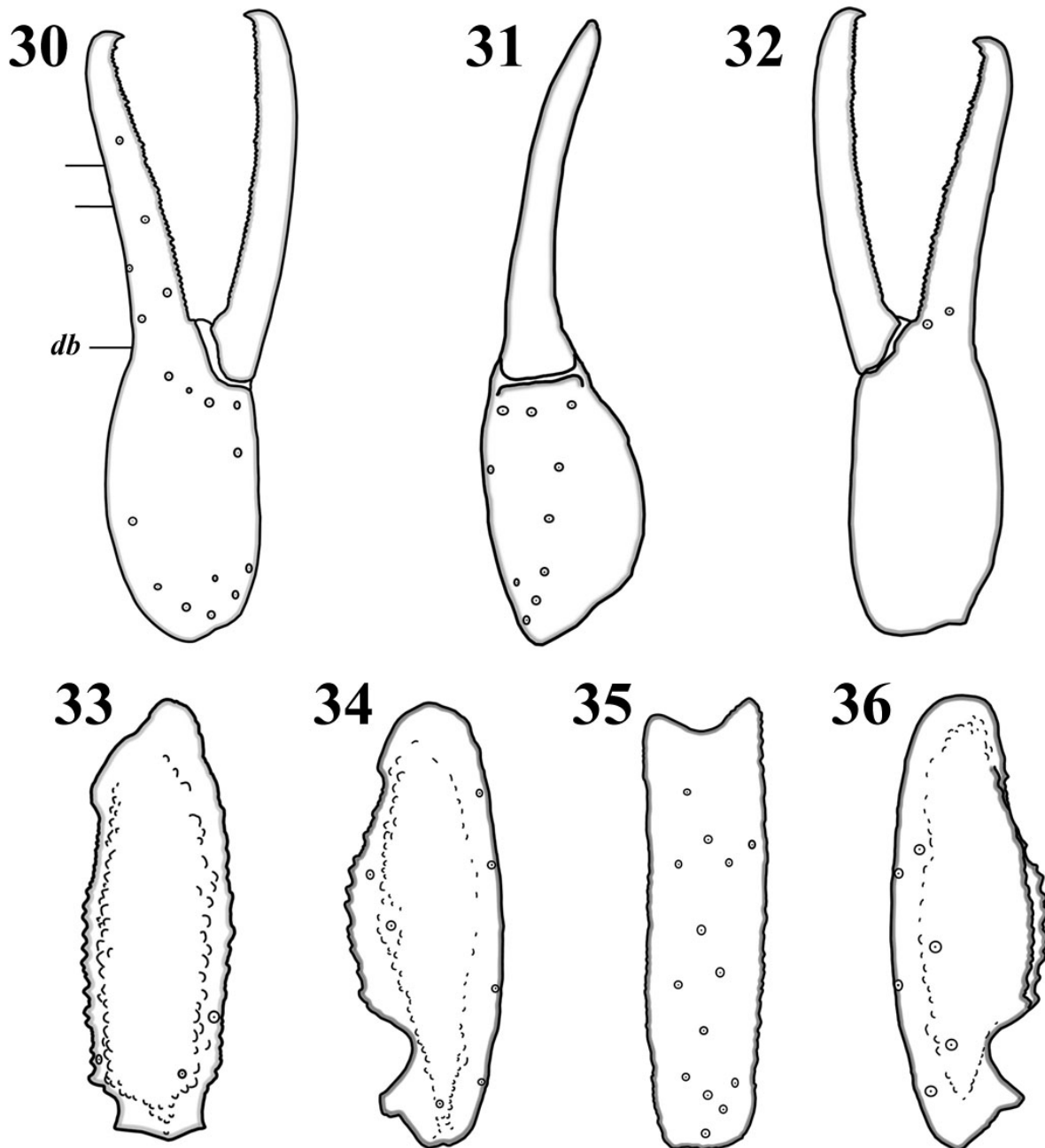
advisor Dr. Victor Fet, for his remarkable contributions to scorpion biology.

Distribution. Known only from Meadow Creek in the Black Mountains of New Mexico, USA.

Description

Color (Figs. 28-29). Base color brown to mahogany with darker mottling. Dark brown to black median eye area. Telson orange to reddish-brown with two dark stripes running longitudinally along ventrolateral surface. Pectines yellow-orange with reddish-orange teeth.

Measurements (in mm). Holotype (female): total

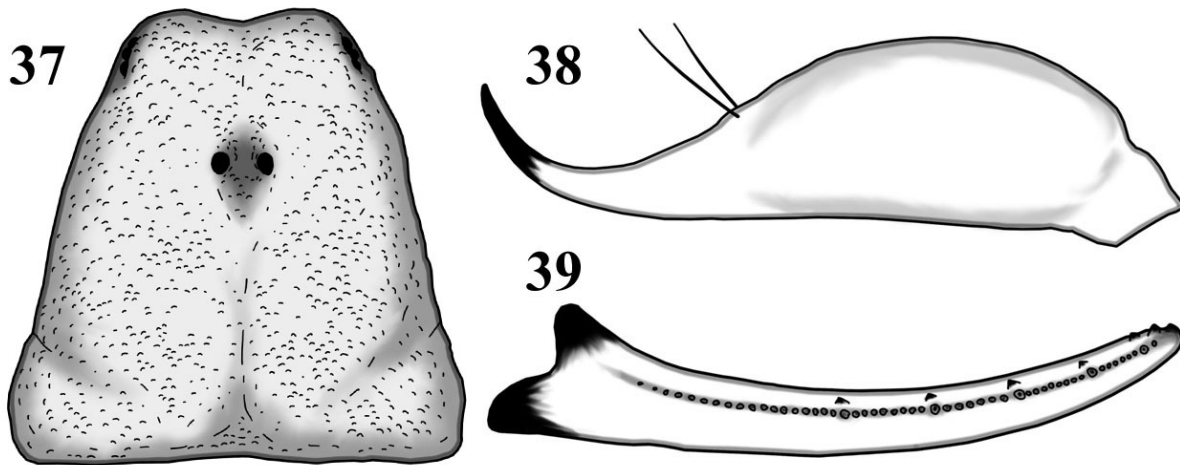


Figures 30–36: Trichobothrial patterns of *Vaejovis feti* sp. nov., based on holotype. **30.** Right pedipalp chela, external. **31.** Right pedipalp chela, ventral. **32.** Right pedipalp chela, internal. **33.** Right pedipalp femur, dorsal. **34.** Right pedipalp patella, dorsal. **35.** Right pedipalp patella, external. **36.** Right pedipalp patella, ventral.

length 22.36; carapace length 3.65; mesosoma length 6.70; metasoma length 9.06; Metasoma: segment I length/width 1.18/1.72; segment II length/width 1.32/1.69; segment III length/width 1.46/1.62; segment IV length/width 2.16/1.55; segment V length/width 2.94/1.51. Telson: length 2.94; vesicle length/width/depth 1.88/1.08/0.82; aculeus length 1.06. Pedipalps: total length 9.79; femur length/width 2.52/0.87; patella length/width 2.71/0.99; chela length 4.56; palm

length/width/depth 1.98/1.18/1.18; movable finger length 2.45; fixed finger length 2.19.

Paratype (male): total length 17.40; carapace length 2.35; mesosoma length 4.80; metasoma length 7.65; Metasoma: segment I length/width 0.99/1.41; segment II length/width 1.18/1.39; segment III length/width 1.27/1.36; segment IV length/width 1.79/1.29; segment V length/width 2.42/1.27. Telson: length 2.26; vesicle length/width/depth 1.53/0.92/0.71; aculeus length 0.73.



Figures 37–39: *Vaejovis feti*, sp. nov., based on holotype. **37.** Carapace, dorsal view (mottling not illustrated). **38.** Telson, lateral view. **39.** Pedipalp chelal finger dentition, right movable finger.

Pedipalps: total length 7.50; femur length/width 1.93/0.64; patella length/width 2.16/0.71; chela length 3.39; palm length/width/depth 1.41/0.87/0.85; movable finger length 2.00; fixed finger length 1.62.

Carapace (Fig. 37). Anterior margin of carapace slightly emarginate with a shallow posterior median furrow. Carapace finely granular with scattered coarse granules.

Mesosoma. Median carina on tergite I obsolete, very slight on tergite II–III, and weak on IV–VI. Tergite VII with weak to moderate median carina and strong crenulate lateral carina.

Genital Operculum. Sclerites separated on posterior one-fifth.

Chelicerae. Dorsal edge of movable finger with two subdistal (*sd*) denticles; ventral edge smooth with conspicuous serrulae on distal half.

Pectines. Pectinal tooth count 10/10 on female holotype, 12/12 on male paratype.

Metasoma. Ratio of segment I length/width 0.69; of segment II length/width 0.78; of segment III length/width 0.90; of segment IV length/width 1.39; of segment V length/width 1.95. Segments I–IV: dorsolateral carinae strong and granular with distal denticle of II–IV enlarged and spinoid; of segment I slightly enlarged and spinoid. Lateral suprmedian carinae I–III strong and granular with enlarged spinoid distal denticle; on IV strong and granular on anterior 1/2 and weak on posterior 1/2, terminus flared. Lateral infrmedian carinae moderately granular on segment I, posterior 2/5 of II, 1/5 of III, and obsolete on IV. Ventrolateral carinae I weak, finely granular; on II–III moderate, granular; on IV–V strong, granular. Ventral submedian carinae granular. Dorsal and lateral intercarinal spaces very finely granular. Ventral submedian setae 3/3:3/3:3/3:3/3. Segment V: Dorsolateral carinae moderate, distally cren-

ulate, basally granular. Lateromedian carinae moderate and granular on basal 3/4, obsolete on distal 1/4. Ventrolateral and ventromedian carinae strong, crenulate. Intercarinal spaces finely granular. Segment V ventrolateral setae 5/5.

Telson (Fig. 38). Smooth with no subaculear tubercle. LAS denticles 6/7 on holotype, 3/6 on paratype.

Pedipalps. Trichobothrial pattern type C (see pattern in Figs. 30–36). Pedipalpal ratios: chela length/width 3.86; femur length/width 2.90; fixed finger length/carapace length 0.60.

Chela. All carinae weak and smooth except dorso-lateral, which is slightly crenulate. All vestigial carinae outlined with dark fuscidity. Fixed fingers: Dentate margin with six subrows of MD denticles divided by five enlarged OD denticles; five ID denticles granules on right finger and six on left. Movable fingers (Fig. 39): Dentate margin with six subrows of MD denticles divided by five enlarged OD denticles; six ID granules. No distinct scalloping on Chela fingers.

Femur. Carinae strong, granulose; internal surface with moderate carinae on proximal 2/3.

Patella. Internal carinae oblique and granulose; all other carinae strong and crenulate.

Legs. Ventral surface of tarsus with single median row of spinules terminating distally with one spinule pair.

Remarks. There appears to be variation in the most proximal ID denticles of the fixed finger of this species. Many that were examined, including the holotype, possess six denticles on one side and five on the other. The sixth OD denticles, when present, also varied in size from barely visible to conspicuous.

Comparison of Species

V. vorhiesi (based on female lectotype and topotype) can be distinguished from *V. cashi* **sp. nov.** (based on female holotype and paratype) by the following morphometric ratios (*V. cashi* **sp. nov.** ratios in parentheses): metasomal segment I length/width 0.80–0.81 (0.70–0.72); metasomal segment II length/width 0.92 (0.83); metasomal segment III length/width 1.02–1.07 (0.94–0.95); metasomal segment IV length/width 1.48–1.53 (1.36–1.38); metasomal segment V length/width 2.21–2.23 (2.05–2.18); metasoma length/carapace length 3.18–3.25 (2.73–2.96); femur length/width 3.07–3.09 (2.92–3.06); telson vesicle width/depth 1.18–1.19 (1.25–1.28); movable finger length/palm length 1.54–1.60 (1.34–1.46); fixed finger length/palm length 1.27–1.30 (1.11–1.15). The pectinal tooth count of females is 12–13 with a mean of 12.389 [18] (11, mean = 11 [4]), based on eight topotype *V. vorhiesi* females and female lectotype.

Significantly different morphometric ratios between *V. vorhiesi* (based on female lectotype and topotype) and *V. feti* **sp. nov.** (based on female holotype) are as follows (*V. feti* **sp. nov.** ratios in parentheses): metasomal segment I length/width 0.80–0.81 (0.69); metasomal segment II length/width 0.92 (0.78); metasomal segment III length/width 1.02–1.07 (0.90); metasomal segment IV length/width 1.48–1.53 (1.39); metasomal segment V length/width 2.21–2.23 (1.95); metasoma length/carapace length 3.18–3.25 (2.48); femur length/width 3.07–3.09 (2.90); telson vesicle width/depth 1.18–1.19 (1.32); movable finger length/fixed finger length 1.20–1.21 (1.12); movable finger length/palm length 1.54–1.60 (1.24); fixed finger length/palm length 1.27–1.30 (1.11). The pectinal tooth count of females is 12–13 with a mean of 12.389 [18] (10, mean = 10 [6]), based on eight topotype *V. vorhiesi* females and female lectotype.

The two new related species, *V. cashi* **sp. nov.** and *V. feti* **sp. nov.**, are most obviously different by their base color, which is brownish in the former and more reddish or mahogany, especially on the pectinal teeth, for the latter. *V. feti* **sp. nov.** also possesses a more robust metasoma relative to carapace size, and more swollen pedipalp palms. Female pectine tooth counts are 10 [12] teeth per comb instead of 11 [4] found in *V. cashi* **sp. nov.** Morphometric ratios vary between the two species as follows: (*V. cashi* **sp. nov.** ratios based on female holotype and paratype in parentheses): metasomal segment III length/width 0.90 (0.95); metasomal segment V length/width 1.95 (2.05–2.18); metasoma length/carapace length 2.48 (2.73–2.96); patella length/width 2.73 (2.83–2.84); movable finger length/fixed finger length 1.12 (1.21–1.26); movable finger length/palm length 1.24 (1.34–1.46); palm length/width 1.68 (1.82–1.86).

The three sky island species, *V. vorhiesi*, *V. cashi*

sp. nov., and *V. feti* **sp. nov.**, all possess 6 ID denticles on the movable pedipalp finger, a trait not shared by any other “mexicanus” group species. Their closest relative, however, is *V. paysonensis*, a superficially very similar species which has the more usual 7 ID denticles on the movable finger. *V. paysonensis* also differs by having a more orangish-brown base color with less mottling. This species is known from Gila County, 40 km northeast of Payson, Arizona. *V. paysonensis* is known from Gila County, 40 km northeast of Payson, Arizona and 340 km northwest of the nearest sky island type locality (Meadow Creek, New Mexico for *V. feti*).

Vaejovis lapidicola Stahnke is also quite similar to the four abovementioned *Vaejovis* sp., but can be easily distinguished by its conspicuously wide and planate carapace. The four others have a more rounded and elongated carapace.

Lastly, a species from near Wupatki National Monument, Arizona, *V. jonesi* Stahnke is also somewhat related. The differences are more obvious, however, as this species is nearly three times as large and has a carapace shorter than metasomal segments I + II. The carapace is markedly shorter in the other five species.

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