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Two new *Vaejovis* C.L. Koch 1836 from highlands of the Sierra Madre Occidental, Durango, Mexico (Scorpiones, Vaejovidae)

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Two new *Vaejovis* C.L. Koch 1836 from highlands of the Sierra Madre Occidental, Durango, Mexico (Scorpiones, Vaejovidae)

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Abstract. Two new species of the mexicanus group of *Vaejovis* C.L. Koch are described from the Madrean pine-oak forests of the Sierra Madre Occidental in the state of Durango, Mexico. These species, *Vaejovis sierrae* sp. nov. and *Vaejovis mcwesti* sp. nov., are distinguished from each other and the only other species of the mexicanus group known from this mountain range, *Vaejovis montanus* Graham and Bryson, by morphometrics, carinal development of the pedipalps, granulation of the metasoma, and body size. A key to the species of the mexicanus group from the Sierra Madre Occidental is provided.

Key words. Chihuahua, Madrean pine-oak forest, new species, scorpion, taxonomy, mexicanus group

Introduction

The Sierra Madre Occidental in western Mexico has been poorly sampled for montane scorpions (Sissom 2000; Sissom and Hendrixson 2005). Only three species of montane scorpions in the speciose family Vaejovidae have been documented from the main masiff of the Sierra Madre Occidental despite this mountain chain being the largest in Mexico (Ferrusquía-Villafranca et al. 2005) and geographically proximate to the United States border (Fig. 1). Two of these vaejovid species, *Vaejovis montanus* Graham and Bryson and *Pseudouroctonus chicano* (Gertsch and Soleglad), are endemic to the Sierra Madre Occidental and the third, *Pseudouroctonus apacheanus* (Gertsch and Soleglad), is also distributed across the uplands of the southwestern United States. Surprisingly, no montane vaejovids have been reported from the highlands in the Mexican state of Durango (Sissom and Hendrixson 2005). However, the type locality of *V. montanus* in Chihuahua is only 40 km from Durango, and it was suggested that additional fieldwork in Durango would probably turn up more montane species (Graham and Bryson 2010). Furthermore, because of the topographic complexity and biogeographic barriers in the region, it

was speculated that these additional species might represent undescribed forms (Graham and Bryson 2010).

During fieldwork in Durango in the summers of 2005 and 2010, two unidentified species of *Vaejovis* C. L. Koch were collected in the Madrean pine-oak forests of the Sierra Madre Occidental. Both species are referable to the mexicanus group of *Vaejovis* based on characters listed by Santibáñez-López and Francke (2010), namely six subrows of denticles on the fixed finger of the pedipalp chela, the position of trichobothria *ib* – *it* at the base of the fixed finger of the pedipalp chela, and the lack of a sclerotized mating plug in the male spermatophore. Here these two new species are described and compared to *V. montanus*, the only other montane species of *Vaejovis* in the mexicanus group from the Sierra Madre Occidental. This brings the total number of montane vaejovids known from the Sierra Madre Occidental to five.

Materials and Methods

Basic nomenclature follows Hjelle (1990); mensuration follows Sissom et al. (1990); trichobothrial designations are after Vachon (1974); setation nomenclature and conventions are after Haradon (1984) for pedipalpal setae, Sissom et al. (2012) for metasomal setae, and McWest (2009) for leg III setae. Setal count data are based on all available specimens. Measurements were taken with a Nikon SMZ 1500 microscope equipped with an ocular micrometer calibrated at 20X. Habitus photos were taken using a Nikon D60 with Micro-Nikkor AF-S 60mm f/2.8G lens. Hemispermatophores were dissected as in Sissom et al. (1990); the right hemispermatophore was cleared in clove oil and photographed at several angles; the drawings were made from the photographs supplemented with detailed observation of the structures. Abbreviations for depositories are as follows: AMNH–American Museum of Natural History; CAS–California Academy of Sciences; and CNAN–Colección Nacional de Arácnidos, Instituto de Biología, Universidad Nacional Autónoma de México.

Taxonomy

Vaejovis sierrae, new species

(Fig. 2–20)

Type data. Holotype male taken from near Rancho Las Margaritas, SE Mezquital, 23.31279°N, 104.30334°W (2724 m), Durango, Mexico on 18 July 2010 by R. W. Bryson, Jr. (CNAN). Paratypes. Four adult, two juvenile females with same data as holotype. Deposited as follows: two adult females (CNAN), one adult female, one juv. female (AMNH), one adult female, one juv. female (CAS).

Etymology. The specific epithet is a patronym named after Sierra Elizabeth Bryson, daughter of the last author.

Distribution. Known only from the type locality (Fig. 1).

Diagnosis. *Vaejovis sierrae* is most similar to *V. montanus* from several localities in Chihuahua. *Vaejovis sierrae* is a smaller species with the single male at 19.62 mm in total length and females (n = 6) ranging from 22.80–27.27 mm (males of *V. montanus* exceed 26 mm and four females measure more than 28 mm in length). *Vaejovis sierrae* has more slender pedipalps (chela length/width in the holotype male is 3.68 and in the paratype females 3.61–3.95), with poorly developed carinae and only the dorsal marginal and dorsointernal carinae with granulation; *V. montanus* has robust pedipalp chelae (chela length/width in the paratype male is 3.33 and in the paratype females 3.55–3.65), with well-developed granulose carinae. *Vaejovis sierrae* has only feeble granulation on the intercarinal spaces of metasomal segment V, whereas *V. montanus* has extensive granulation on these surfaces. The pedipalp patella bears a weak basal tubercle on the internal (prolateral) face in *V. sierrae*, but a strong tubercle in *V. montanus*. Lastly, the dorsolateral carinae of metasomal segments I–IV bear 0:0:0:1 (86%) or 0:0:1:1

(14%) setae (n = 14 carinae) in *V. sierrae*, whereas the counts are 0:0:1:1 (100%) in *V. montanus* (n = 10 carinae).

Description. The following description is based on the holotype male.

Coloration (Fig. 2–5). Carapace and tergites yellowish brown, with distinct pattern of dusky markings. Metasomal segments light orange brown; dorsal markings limited to posterior ends of carinae and small dark spots in dorsal intercarinal spaces; lateral fuscosity more extensive, associated with the carinae, setal pits, and intercarinal spaces; ventral fuscosity limited to carinae and setal pits; metasoma V with heavier fuscosity in posterior half. Telson orange brown with a few small lateral dusky spots; aculeus dark reddish brown. Cheliceral manus yellowish, dorsally with distal edge and movable finger bearing dusky markings; cheliceral teeth dark brown. Pedipalp femur and patella orange brown with small amounts of fuscosity located at or near trichobothrial setal pits. Pedipalp chela orange brown with fuscous spots surrounding trichobothria and setal pits and a band of fuscosity at distal end of manus which extends well onto fixed finger. Carinae of pedipalps and metasoma dark brown to reddish brown. Coxosternal region and sternites III–VI yellow brown, unmarked; sternite VII yellow brown with moderate fuscosity. Legs lighter yellow brown with strong fuscosity.

Prosoma. Carapace length slightly greater than posterior width; ratio of carapace L/metasomal segment V length 0.91. Median ocular prominence slightly raised above carapacial surface. Anterior margin obtusely emarginate; median notch rounded. Carapace densely finely granular, with scattered coarse granulation associated with fuscous areas.

Mesosoma. Median carina absent on I–II; on III–VI represented by faint granular ridges. Tergite VII with median carina present, weak on anterior half, granular; both pairs of lateral carinae strong, serratocrenulate. Pre-tergites densely finely granular; post-tergites densely, finely granular with scattered coarse granulation in fuscous areas. Pectinal teeth numbering 13/13. Sternite III with an anterior medial macroseta and a transverse, recurved row of four macrosetae near midsegment; sternites IV–VI with two macrosetae anterior to each book lung spiracle (lateral macroseta missing on right side of sternite IV) and a transverse, recurved row of four macrosetae near mid-segment; sternite VII with three pairs lateral setae (two of these on lateral carina) and one pair of medial setae; all five sternites with regularly spaced lateral and posterior marginal macrosetae. Sternite V with an inconspicuous medial pale patch along posterior margin; anterior edge of patch evenly convex. Sternites III–VII shagreened medially, with granulation laterally (stronger and more dense on posterior sternites). Sternite VII with one pair of moderate, granulose lateral carinae.

Metasoma (Fig. 6). Segment I length/width ratio 0.75, III length/width ratio 1.04, V length/width ratio 2.32. Segments I–IV: Dorsolateral carinae strong, irregularly serratocrenulate; terminal denticles distinctly enlarged, spinoid. Lateral supramedian carina on I strong, serratocrenulate, on II–III strong, crenulate; terminal denticles enlarged, spinoid on I–III, flared on IV. Lateral inframedian carinae on I strong, complete, granulose; on II present on posterior one-half, stronger posteriorly, crenulate; on III present on posterior one-third, stronger posterior, crenulate; on IV absent. Ventrolateral carinae on I moderate, serratocrenulate; on II–IV strong, serratocrenulate. Ventral submedian carinae on I weak, crenulate; on II moderate, crenulate; on III–IV strong, crenulate. Intercarinal spaces densely, finely granular with a few scattered coarse granules in fuscous areas. Segment V: Dorsolateral carinae stronger anteriorly, granulose. Lateromedian carinae moderate basally, weak distally; present on anterior three-fourths, granulose. Ventrolateral and ventromedian carinae strong, serrate. Intercarinal surfaces densely finely granular, with a few coarse granules ventrally in fuscous areas. Metasomal I–IV carinal setation: dorsolaterals, 0/0:0/0:0/0:1/1; lateral supramedians, 0/0:1/1:1/1:2/2; lateral inframedians, 1/1:0/0:0/0:0/0; ventrolaterals, 2/2:3/2:2/2:3/3; ventral submedians, 3/3:3/3:3/3:4/3; ventromedian intercarinal spaces lacking accessory setae. Setation of metasomal segment V: dorsolaterals, 3/3; lateromedians, 2/2; ventrolaterals, 4/4; ventromedians, 1/1 + 2/2.

Telson (Fig. 6). Moderately slender, distinctly narrower than metasoma V and with length/depth ratio 2.39. Dorsal surface of telson with a distinct pale, elongate oval depression. Underside of vesicle with eight pairs of macrosetae and several smaller paired setae, especially at the base. Ventral aspect of telson with sparse, scattered granulation.

Chelicera. Movable finger dorsally with one large distal tine, one smaller subdistal tine (two on left side, with distalmost arising from distal tine), one large medial tine, and one small basal tine. Ventral margin of cheliceral movable finger with well-developed serrula.

Pedipalp. Trichobothrial pattern, Type C, orthobothriotaxic (Fig. 7–15). Femur (Fig. 7): length/width ratio 2.92. Tetracarinate: dorsointernal carina moderate, irregularly crenulate; dorsoexternal carinae moderate, granulose; ventrointernal carina strong, crenulate; ventroexternal carina weak, granular. All faces densely, finely granular; internal face additionally with about 20 larger, irregularly-spaced, rounded granules. Internal face with one supramedial macroseta and three inframedial macrosetae; external face with two medial macrosetae. Patella (Fig. 8–10). Length/width ratio 2.57. Pentacarinate. Dorsointernal carina moderate, irregularly crenulate; internomedian carina oblique, moderate, granulose, without pronounced basal tubercle; ventrointernal carina moderate, serrate; dorsoexternal and ventroexternal carinae moderate, granular. All faces densely, finely granular. Internal face with two supramedial and two inframedial macrosetae. Chela (Fig. 11–15). Dorsal marginal carina weak, with a few small granules distally; dorsal secondary, digital, and external secondary carinae represented by faint, smooth, rounded ridges; dorsointernal carina weak, with several medium-sized granules; ventrointernal carina weak, with a few small granules; ventromedian and ventroexternal carinae absent. Intercarinal surfaces shagreened, with a few coarse granules at base of fixed finger. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged denticles; six inner accessory denticles (Fig. 14). Dentate margin of movable finger with primary row divided into six subrows by five enlarged denticles; apical subrow consisting of a single denticle; six inner accessory denticles (Fig. 15). Dentate margins of chela fingers straight in lateral profile. Chela length/width ratio 3.68; fixed finger length/carapace length ratio 0.66.

Leg. Telotarsus III with ventromedian spinule row terminating between a single pair of enlarged spinules; thirteen macrosetae (excluding superoterminal landmark macroseta) as follows (L/R): *ri* 1/1, *rid* 1/1, *rit* 1/1, *rm* 1/1, *rmt* 1/1, *rs* 1/1, *rst* 1/1, *pi* 1/1, *pid* 1/1, *pit* 1/1, *pm* 1/1, *pmt* 1/1, *pst* 1/1.

Hemispermatophore (Fig. 16–20). Lamelliform with strong dorsal crest on distal lamina extending approximately one-third the length of the blade; distal lamina with basal constriction, widening at middle, and distinctly tapering distally. Two dorsal "hooks" positioned just above the dorsal trough, with ectal hook distinctly larger. Ventral capsular area with a flat, rounded plate bearing a sharp prong which projects ectally.

Measurements of Male Holotype (mm). Total L (additive), 19.62; carapace L, 2.58; mesosoma L, 6.25; metasoma L (additive), 8.14; telson L, 2.65 (missing aculeus tip). Metasomal segments: I L/W, 1.07/1.43; II L/W, 1.22/1.38; III L/W, 1.33/1.35; IV L/W, 1.68/1.28; V L/W, 2.83/1.22. Telson: vesicle L/W/D, 1.84/0.97/0.77; aculeus L, 0.82 (tip broken off). Pedipalps: femur L/W, 2.07/0.71; patella L/W, 2.24/0.87; chela L/W/D, 3.57/0.97/1.02; fixed finger L, 1.71; movable finger L, 2.14; palm (underhand) L, 1.63.

Measurements of Female Paratype (mm). Total L (additive), 22.52; carapace L, 3.08; mesosoma L, 7.40; metasoma L (additive), 9.00; telson L, 3.06. Metasomal segments: I L/W, 1.17/1.73; II L/W, 1.38/1.63; III L/W, 1.45/1.56; IV L/W, 1.94/1.53; V L/W, 3.06/1.48. Telson: vesicle L/W/D, 1.94/1.07/0.87; aculeus L, 1.12. Pedipalps: femur L/W, 2.30/0.79; patella L/W, 2.45/0.97; chela L/W/D, 3.99/1.01/1.02; fixed finger L, 1.99; movable finger L, 2.50; palm (underhand) L, 1.66.

Variation. The six female specimens exhibited pectinal tooth counts as follows: three combs with 12 teeth, six combs with 13 teeth, two combs with 14 teeth, and one damaged. Four of the seven specimens available had six inner accessory denticles on the chela movable finger, one had six on the right side and seven on the left, and two had seven on both fingers. The cheliceral movable finger in all specimens except the holotype has two subdistal teeth, but in almost all cases, the distalmost of the two actually arises from the posterior edge of the larger distal tine.

There was no observed variation in the numbers of macrosetae on the pedipalpal femur (internal supramedials and inframedials; external medians) and patella (internal supramedians and inframedians). There was some variation in metasomal segments I–IV setal counts (n = 14 carinae), as follows: dorsolaterals, 0:0:0:1 (n = 12; 86%), 0:0:1:1 (n = 2; 14%); lateral supramedians, 0:1:1:2 (100%); lateral inframedians, 1:0:0:0 (n = 9; 64%), 1:0:0:1 (n = 3; 21%), 1:0:1:1 (n = 1; 14%), 1:0:1:0 (n = 1; 14%); ven-

trolaterals, 2:2:2:3 (n = 8; 57%), 2:2:3:3 (n = 2; 28%), 2:2:2:4 (n = 2; 28%), 2:2:2:3 (n = 2; 14%), 2:3:3:2 (n = 1; 14%); and ventral submedians I-IV, 3:3:3:3 (n = 11; 79%), 3:3:3:4 (n = 3; 21%). For segment V, all specimens had three dorsolaterals, 2 lateromedians, and four ventrolaterals; the ventromedian carinae bore 2+2 (n = 9; 64%) or 1+2 macrosetae (n = 5; 36%).

Comments. The dorsal surface of the telson of the male holotype bears an oval-shaped excavation in the position often occupied by telson glands in other vaejovids. However, this particular feature is very unusual, and because it is limited to a single observation, it is unclear whether it represents an aberration or a true character that might have taxonomic value.

***Vaejovis mcwesti*, new species**
(Fig. 21–39)

Type Data. Holotype male taken from Hwy 36, km 32, between San Andres Atotonilco and Laguna La Chaparra (W Santiago Papasquiaro), 25.07565ºN, 105.61933ºW (2787 m), Durango, Mexico on 11 Aug 2005 by O. F. Francke, W. D. Sissom, K. J. McWest, C. M. Lee, H. Montaño, J. Ballesteros, L. Jarvis, and C. Duran-Barron (CNAN). Paratypes. Five adult females with same data as holotype deposited as follows: two females (AMNH), two females (CNAN), and one female (CAS).

Etymology. The specific epithet honors Kari J. McWest, longtime friend and collaborator of the first author, for his contributions to the understanding of scorpion diversity in the southwestern USA and Mexico.

Distribution. Known only from the type locality (Fig. 1).

Diagnosis. *Vaejovis mcwesti* is most similar to *V. montanus* and *V. sierrae*. *Vaejovis mcwesti* has more robust pedipalps (chela length/width in the holotype male is 3.16 and in the paratype females 3.25–3.42), with weaker carinae and only the dorsal marginal and dorsointernal carinae with granulation; *V. montanus* has more slender pedipalp chelae (chela length/width in the paratype male is 3.33 and in the paratype females 3.55–3.65), with well-developed granulose carinae. *Vaejovis mcwesti* has only light to moderate granulation on the intercarinal spaces of metasomal segment V, whereas *V. montanus* has extensive coarse granulation on these surfaces. The lateral carinae of sternite VII are weak and lightly granular in *V. mcwesti*, but strong and granulose in *V. montanus*.

Vaejovis sierrae is a smaller species with the single male at 19.62 mm in total length and females (n = 6) ranging from 22.80–27.27 mm. *Vaejovis sierrae* also has more slender pedipalps (chela length/width in the holotype male is 3.68 and in the paratype females 3.61–3.95). The pedipalp patella bears a weak basal tubercle on the internal (prolateral) face in *V. sierrae*, but a strong tubercle in *V. mcwesti*. Lastly, the dorsolateral carinae of metasomal segments I–IV bear 0:0:0:1 (86%) or 0:0:1:1 (14%) setae (n = 14 carinae) in *V. sierrae*, whereas the counts are 0:0:1:1 (66.7%) or 0:1:1:1 (33.3%) in *V. mcwesti* (n = 12 carinae); for the lateral inframedian carinae, the counts are 1:0:0:0 (64.3%), 1:0:0:1 (21.4%), 1:0:1:0 (7.1%), or 1:0:1:1 (7.1%) in *V. sierrae*, and 2:1:1:1 (83.3%) or 2:1:0:1 (16.7%) in *V. mcwesti*.

Description. The following description is based on the holotype male.

Coloration (Fig. 26–29). Carapace and tergites dark yellowish brown, with extensive pattern of dusky markings. Metasomal segments light orange brown, gradually darkening to orange brown distally; dorsal markings limited to posterior ends of carinae and large patches in the dorsal intercarinal spaces; lateral fuscosity more extensive, associated with the carinae, setal pits, and intercarinal spaces, particularly in the posterior halves of the segments; ventral fuscosity moderate to strong on carinae, setal pits, and distal intercarinal spaces; metasoma V with heavy fuscosity in distal half of dorsal intercarinal spaces and dorsolateral carinae, the distal half of lateral intercarinal spaces and the lateromedian and ventrolateral carinae, and the ventral setal pits and ventrodistal end of the segment. Telson orange brown with very weak dusky markings anteriorly and around setal pits; aculeus dark reddish brown. Cheliceral manus yellowish, dorsally with distal edge and movable finger bearing dusky

markings; cheliceral teeth dark brown. Pedipalp femur orange brown with extensive fuscosity dorsally and around the trichobothrial pits on internal and external faces. Pedipalp patella orange brown with extensive fuscosity on dorsal and external faces and moderate fuscosity on internal face. Pedipalp chela orange brown with strong fuscosity around distal part of manus and proximal one-half of chela fingers; ventral aspect of palm with strong fuscous band. Coxosternal region and sternites III–VI yellow brown, unmarked; sternites III–VI yellow brown with light to moderate fuscosity along midline, lateral edges, and setal pits; VII yellow brown with strong fuscosity laterally, weak fuscosity medially. Legs lighter yellow brown with strong fuscosity.

Prosoma. Carapace length slightly greater than posterior width; ratio of carapace L/metasomal segment V length 0.88. Median ocular prominence slightly raised above carapacial surface. Anterior margin obtusely emarginate; median notch rounded. Carapace densely finely granular, with scattered coarse granulation associated with fuscous areas.

Mesosoma. Median carina absent on I–II; on III–IV represented by faint granular ridges; on V weak, granular; on VI moderate, granular. Tergite VII with median carina moderate on anterior three-fifths, granular; both pairs of lateral carinae strong, serratocrenulate. Pre-tergites densely finely granular; post-tergites densely, finely granular with scattered coarse granulation in fuscous areas. Pectinal teeth numbering 14/14. Sternite III with a pair of anterior medial macrosetae and a transverse, recurved row of five macrosetae (three on left, two on right) near midsegment; sternites IV–VI with two lateral macrosetae anterior to each book lung spiracle and a transverse, recurved row of four macrosetae near mid-segment (only three on fifth sternite); sternite VII with three pairs lateral setae (two of these on lateral carina) and one pair of medial setae; all five sternites with regularly spaced lateral and posterior marginal macrosetae. Sternite V with a distinct, large medial pale patch along posterior margin; anterior edge of patch evenly convex. Sternites III–VI shagreened, sublustrous medially, with fine granulation laterally (stronger and more dense on posterior sternites); sternite VII densely finely granular, with one pair of weak, feebly granular lateral carinae.

Metasoma (Fig. 30). Segment I length/width ratio 0.76, III length/width ratio 1.00, V length/width ratio 2.30. Segments I–IV: Dorsolateral carinae strong, irregularly serratocrenulate; terminal denticles distinctly enlarged, spinoid. Lateral supramedian carinae on I strong, serratocrenulate, on II–III strong, crenulate; terminal denticles enlarged, spinoid on I–III, flared on IV. Lateral inframedian carinae on I strong, complete, granulose; on II-III present on posterior one-third, strong, crenulate to granular; on IV absent. Ventrolateral carinae strong, serratocrenulate. Ventral submedian carinae on I weak, granular; on II moderate, crenulate; on III–IV strong, crenulate. Intercarinal spaces densely, finely granular with a few scattered coarse granules in fuscous areas. Segment V: Dorsolateral carinae strong, serrate anteriorly, granulose at middle and distally. Lateromedian carinae strong on basal three-fifths, granulose. Ventrolateral and ventromedian carinae strong, serrate. Intercarinal surfaces densely finely granular, with a few coarse granules ventrally in fuscous areas. Metasomal I–IV carinal setation: dorsolaterals, 0/0:1/0:1/1:1/1; lateral supramedians, 0/0:1/1:1/1:2/2; lateral inframedians, 2/2:1/1:1/1:1/1; ventrolaterals, 2/2:3/3:3/3:3/3; ventral submedians, 3/3:3/3:3/4:4/5.Setation of metasomal segment V: dorsolaterals, 3/3; lateromedians, 3/2; ventrolaterals, 5/4 (distally a small fifth seta on left); ventromedians, 2/2 + 2/2.

Telson (Fig. 30). Moderately slender, distinctly narrower than metasoma V and with length/depth ratio 2.16. Dorsal surface of vesicle flat with wide suboval medial whitish patch. Underside of vesicle with 8 pairs of larger reddish macrosetae and several smaller paired setae. Ventral aspect of telson with moderately dense, low, coarse granulation.

Chelicera. Movable finger dorsally with one large distal tine, two smaller subdistal tines (with distalmost arising from distal tine), one large medial tine, and one small basal tine. Ventral margin of cheliceral movable finger with well-developed serrula.

Pedipalp. Trichobothrial pattern, Type C, orthobothriotaxic, (Fig. 31–39). Femur (Fig. 31): length/width ratio 2.91. Tetracarinate: dorsointernal carina moderate, irregularly crenulate; dorsoexternal carinae strong, granulose; ventrointernal carina strong, crenulate; ventroexternal carina weak, granular. All faces densely, finely granular; internal face additionally with about eight larger, irregularly-spaced, rounded granules most of which are associated with setal pits. Internal face with one supramedial macroseta and three inframedial macrosetae; external face with two medial macrosetae. Patella (Fig. 32–34). Length/width ratio 2.78. Pentacarinate. Dorsointernal carina moderate, irregularly crenulate; internomedian carina oblique, moderate, granulose, without pronounced basal tubercle; ventrointernal

carina strong, serratocrenulate; dorsoexternal and ventroexternal carinae moderate, granular. All faces densely, finely granular. Internal face with two supramedial and two inframedial macrosetae. Chela (Fig. 35–39). Dorsal marginal carina weak, granular; dorsal secondary, digital, external secondary, and ventrointernal carinae represented by weak, smooth, rounded ridges; dorsointernal carina weak, with some larger granules; ventromedian and ventroexternal carinae absent. Dorsal, external, and internal intercarinal surfaces shagreened, with dense fine granulation in carinal areas and some coarse granules at base of fixed finger. Dentate margin of fixed finger with primary denticle row divided into six subrows by five enlarged denticles; six inner accessory denticles (Fig. 38). Dentate margin of movable finger with primary row divided into six subrows by five enlarged denticles; apical subrow consisting of a single denticle; seven inner accessory denticles (Fig. 39). Dentate margins of chela fingers straight in lateral profile. Chela length/width ratio 3.16; fixed finger length/carapace length ratio 0.67.

Leg. Telotarsus III with ventromedian spinule row terminating between a single pair of enlarged spinules; seventeen macrosetae (excluding superoterminal landmark macroseta) as follows (R/L): *ri* 1/2, *rid* 1/1, *rit* 1/1, *rm* 1/1, *rmt* 1/1, *rs* 1/1, *rst* 1/1, *pi* 2/2, *pid* 1/1, *pit* 1/1, *psub* 1/1, *pm* 2/1, *pmt* 1/1, *pst* 1/1 (after McWest 2009).

Hemispermatophore (Fig. 21–25). Lamelliform with strong dorsal crest on distal lamina extending approximately one-third the length of the blade; distal lamina with basal constriction, widening at middle, and tapering distally. Two dorsal "hooks" positioned just above the dorsal trough, with ental hook distinctly larger. Ventral capsular area with a flat, rounded plate bearing a sharp prong which projects ectally.

Measurements of Male Holotype (mm). Total L (additive), 23.79; carapace L, 3.11; mesosoma L, 6.96; metasoma L (additive), 10.28; telson L, 3.44. Metasomal segments: I L/W, 1.38/1.81; II L/W, 1.56/1.73; III L/W, 1.68/1.68; IV L/W, 2.14/1.58; V L/W, 3.52/1.53. Telson: vesicle L/W/D, 2.27/1.33/1.05; aculeus L, 1.17. Pedipalps: femur L/W, 2.53/0.87; patella L/W, 2.70/0.97; chela L/W/D, 4.52/1.43/1.43; fixed finger L, 2.07; movable finger L, 2.60; palm (underhand) L, 2.07.

Measurements of Female Paratype (mm). Total L (additive), 22.33; carapace L, 2.96; mesosoma L, 7.30; metasoma L (additive), 8.98; telson L, 3.09. Metasomal segments: I L/W, 1.17/1.66; II L/W, 1.38/1.56; III L/W, 1.48/1.48; IV L/W, 1.89/1.48; V L/W, 3.06/1.48. Telson: vesicle L/W/D, 1.99/1.17/0.89; aculeus L, 1.10. Pedipalps: femur L/W, 2.35/0.79; patella L/W, 2.50/0.92; chela L/W/D, 4.08/1.20/1.28; fixed finger L, 1.94; movable finger L, 2.40; palm (underhand) L, 1.84.

Variation. The five female specimens exhibited pectinal tooth counts as follows: one comb with 12 teeth, eight combs with 13 teeth, and one comb with 14 teeth.

The cheliceral movable fingers in five of the specimens have two subdistal teeth with the distalmost of the two actually arising from the posterior edge of the larger distal tine; in the sixth specimen, the distalmost subdistal tine is reduced on the left and represented by a small denticle on the right.

There was no variation in chela finger dentition: all specimens had six subrows flanked by six inner accessory denticles on the chela fixed finger, and six subrows flanked by seven inner accessory denticles on the movable finger.

There was no observed variation in the numbers of macrosetae on the pedipalpal femur (internal supramedials and inframedials; external medians) and patella (internal supramedians and inframedians). Variation in metasomal segments I–IV setal counts (n = 12 carinae) was as follows: dorsolaterals, 0:0:1:1 (n = 8; 67%), 0:1:1:1 (n = 4; 33%); lateral supramedians, 0:1:1:2 (n = 9; 75%), 0:1:2:2 (n = 1; 8%), 1:1:1:2 (n = 1; 8%), 0:1:1:3 (n = 1; 8%); lateral inframedians, 2:1:1:1 (n = 10; 83%), 2:1:0:1 (n = 2; 17%); ventrolaterals, 2:3:3:3 (n = 5; 42%), 2:3:3:4 (n = 2; 17%), 2:2:3:4 (n = 2; 17%), 2:3:4:5 (n = 2; 17%), 2:4:3:5 (n = 1; 8%); and ventral submedians I-IV, 3:3:3:4 (n = 4; 33%), 3:3:4:5 (n = 2; 17%), and one each (8%) bearing 3:3:3:3, 3:4:4:4, 3:4:4:5; 3:3:5:5, 3:3:3:6, and 3:4:3:5. For segment V, 11/12 (92%) specimens had three dorsolaterals and 1/12 (8%) had four; 8/12 (67%) had three lateromedians and 4/12 (33%) had two; 8/12 (67%) had four ventrolaterals and the remaining counts were 5 (3/12; 25%) and 7 (1/12; 8%); the ventromedian carinae bore 2+2 (n = 4; 33%) macrosetae, 4+2 (n = 4; 33%), 3+2 (n = 3; 25%), or 1+2 macrosetae (n = 1; 8%).

Variation in prolateral telotarsus III setation is as follows (one specimen missing right tarsus): pi, 7/11 legs had three and 4/11 had two; psub, 8/11 with one and 3/11 had none; pm, 10/11 with one and 1/11 with two; pmt, 10/11 with one, 1/11 with two; no variation in other counts.

Key to the Species of the mexicanus **Group of *Vaejovis* C.L. Koch 1836 from the Sierra Madre Occidental:**

1. Dorsal marginal, digital, dorsal secondary, ventroexternal, and dorsointernal carinae of pedipalp chelae well developed, granular to granulose ..... ***V. montanus* Graham and Bryson 2010**
— Pedipalp chela with carinae weakly developed, only dorsal marginal and digital carinae with granulation **2**

2. Pedipalp more slender (Fig. 10), with chela length/width ratio greater than 3.68 in known male and 3.61–3.95 in known females; dorsolateral carinae of metasomal segments I–IV with 0:0:0:1 setae (Fig. 6); lateral inframedian carinae of metasomal segments I–IV typically with 1:0:0:0 setae (Fig. 6) ..... ***V. sierrae* sp. nov.**
— Pedipalp more robust (Fig. 34), with chela length/width ratio 3.16 in known male, 3.28–3.48 in known females; dorsolateral carinae of metasomal segments I–IV with 0:0:1:1 or 0:1:1:1 setae (Fig. 30); lateral inframedian carinae of metasomal segments I–IV typically with 2:1:1:1 setae (Fig. 30) ..... ***V. mcwesti* sp. nov.**

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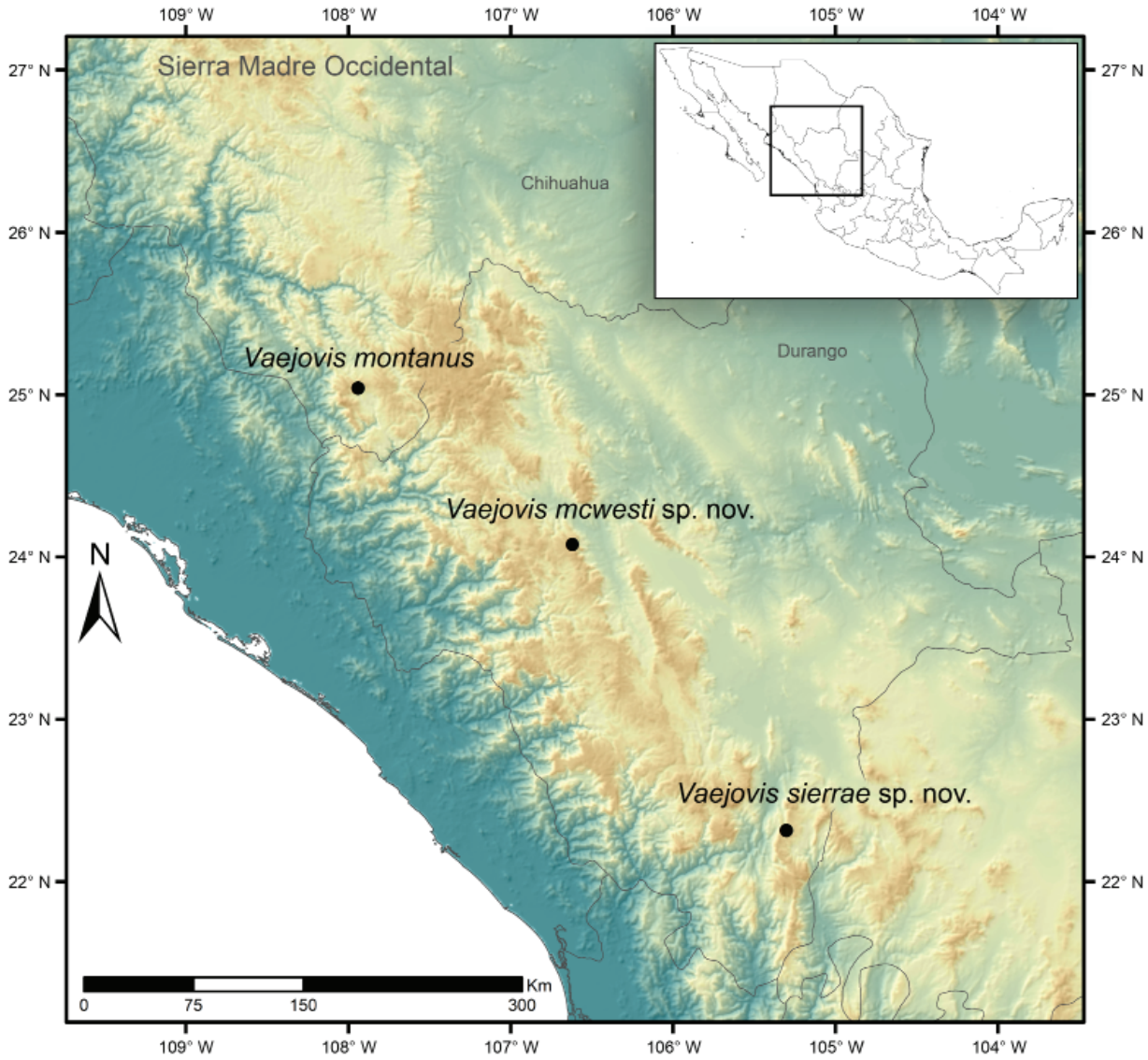
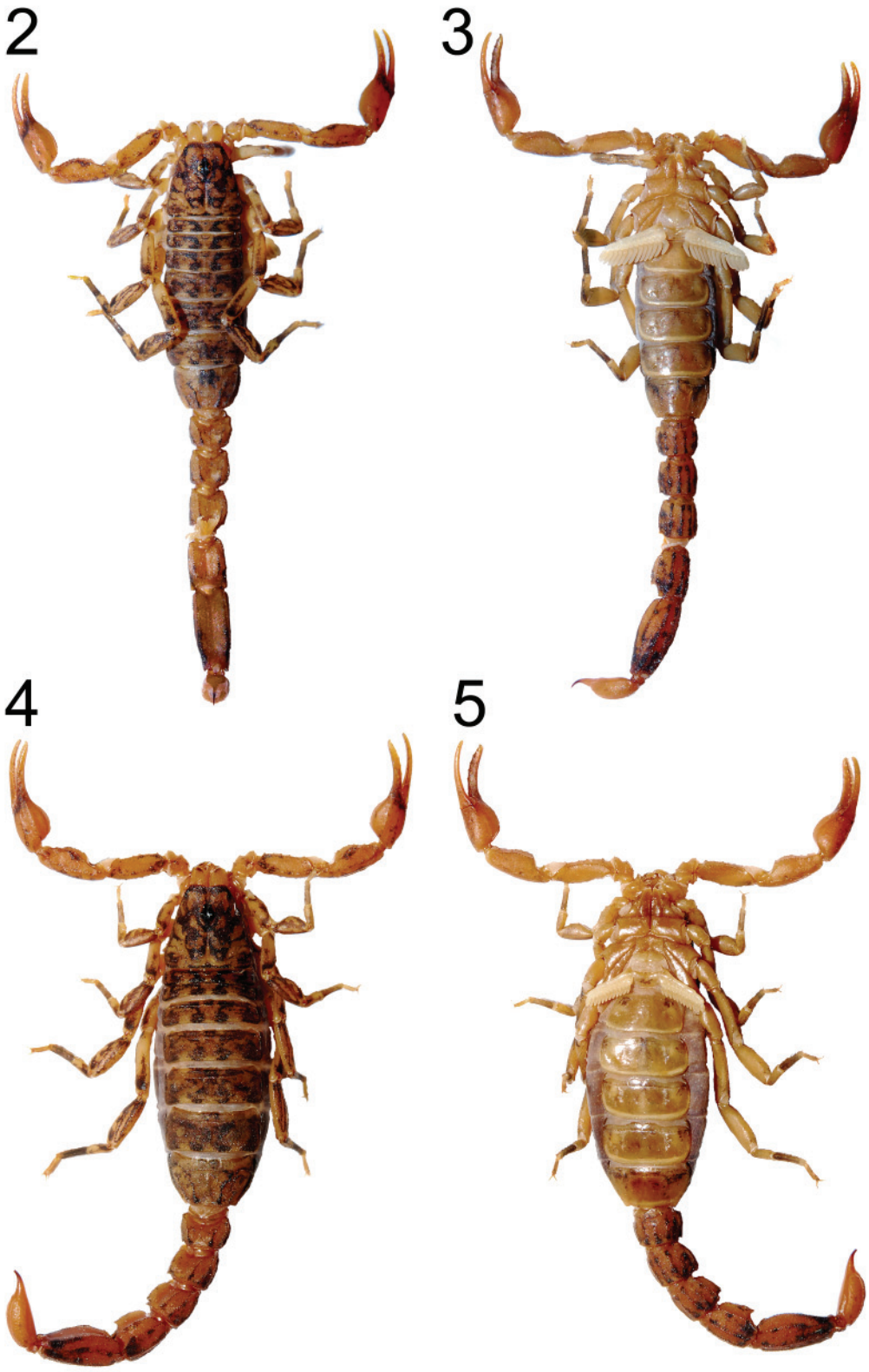
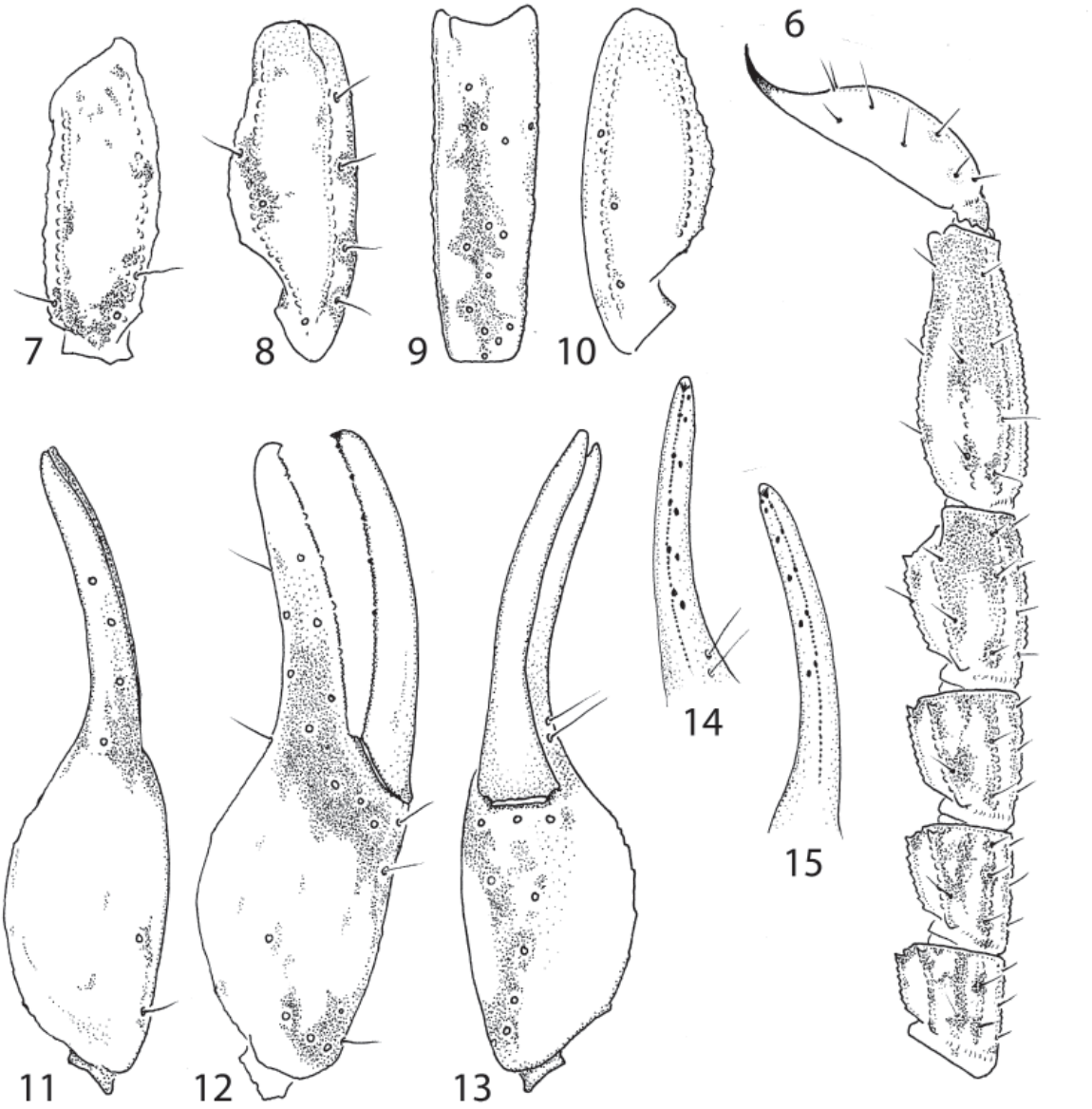


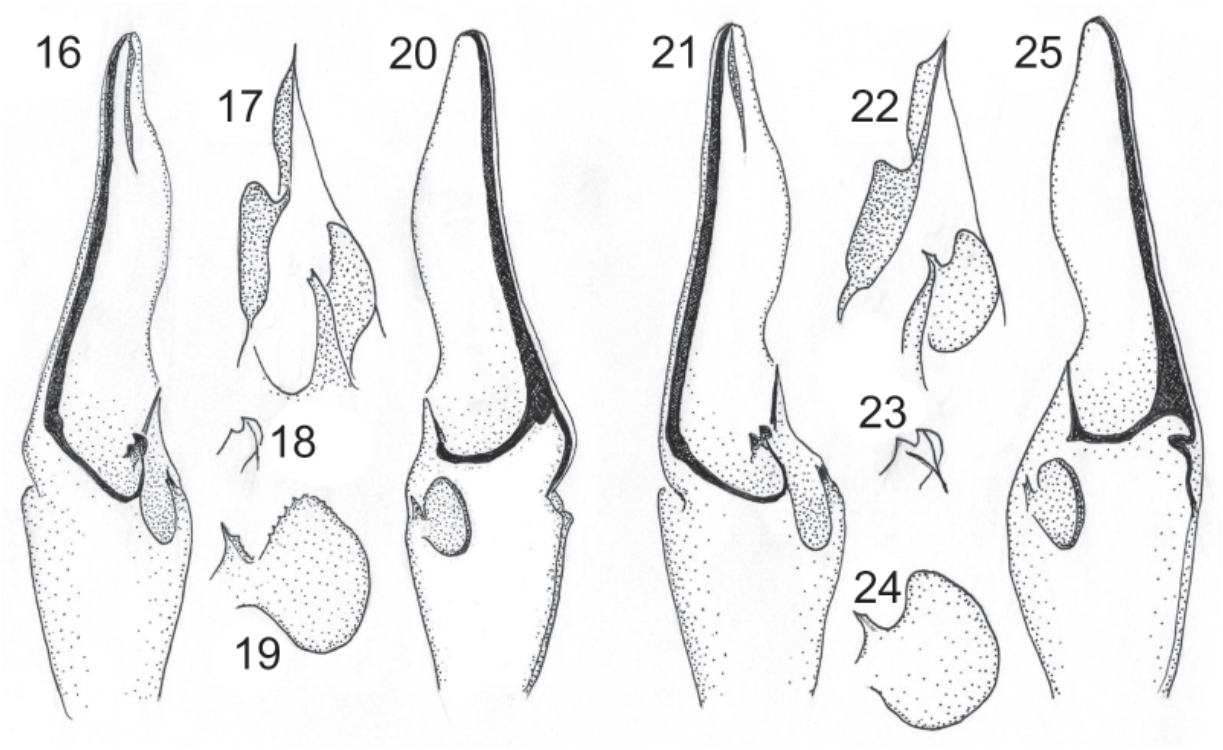
Figure 1. Type localities of species of the mexicanus group of *Vaejovis* C. L. Koch 1836 from the Sierra Madre Occidental: *Vaejovis sierrae* sp. nov., *V. mcwesti* sp. nov., and *V. montanus* Graham and Bryson 2010.



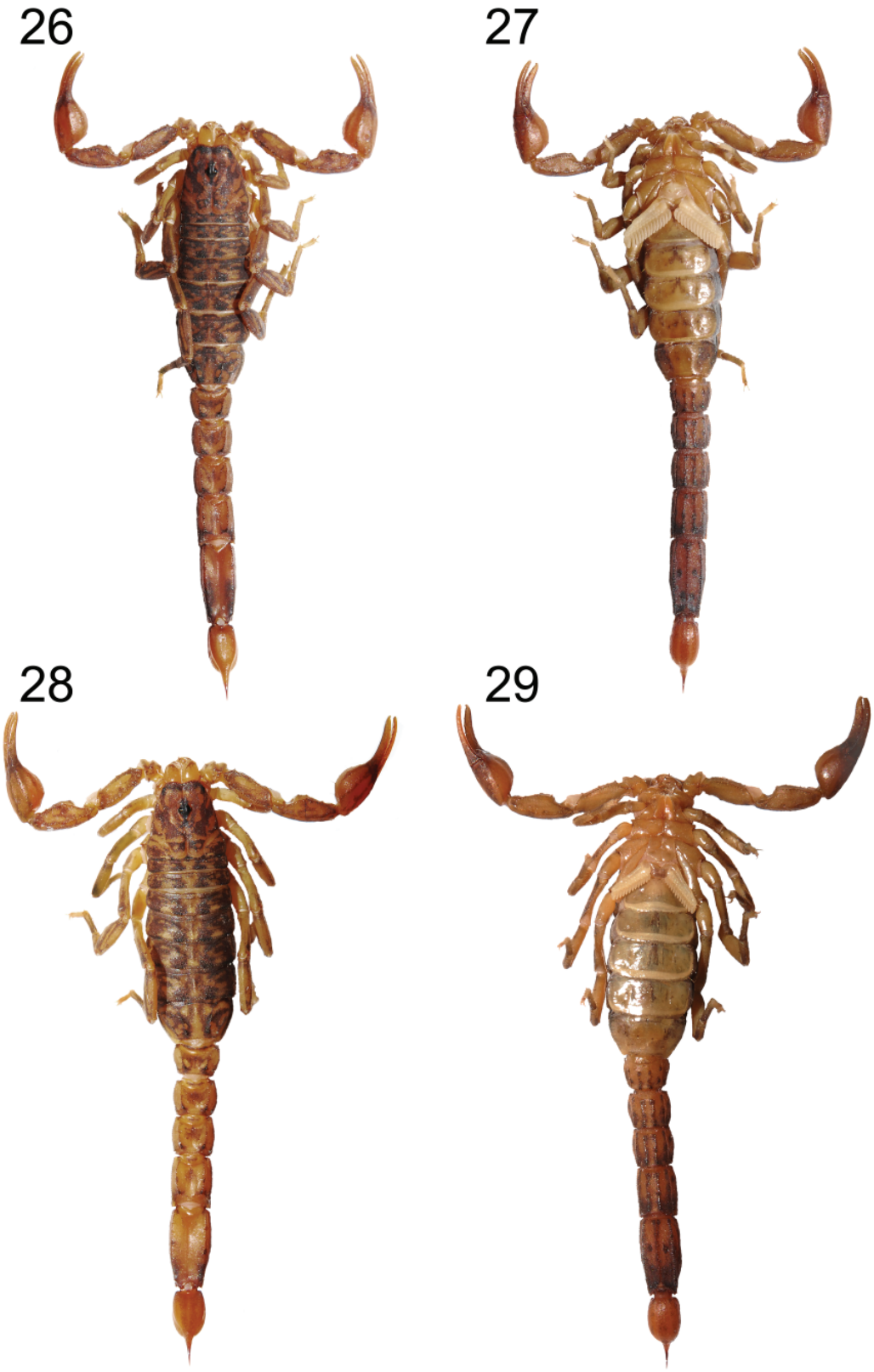
Figures 2–5. *Vaejovis sierrae* sp. nov., from near Rancho Las Margaritas, Durango, Mexico. **2)** Dorsal aspect, male holotype. **3)** Ventral aspect, male holotype. **4)** Dorsal aspect, female paratype. **5)** Ventral aspect, female paratype.



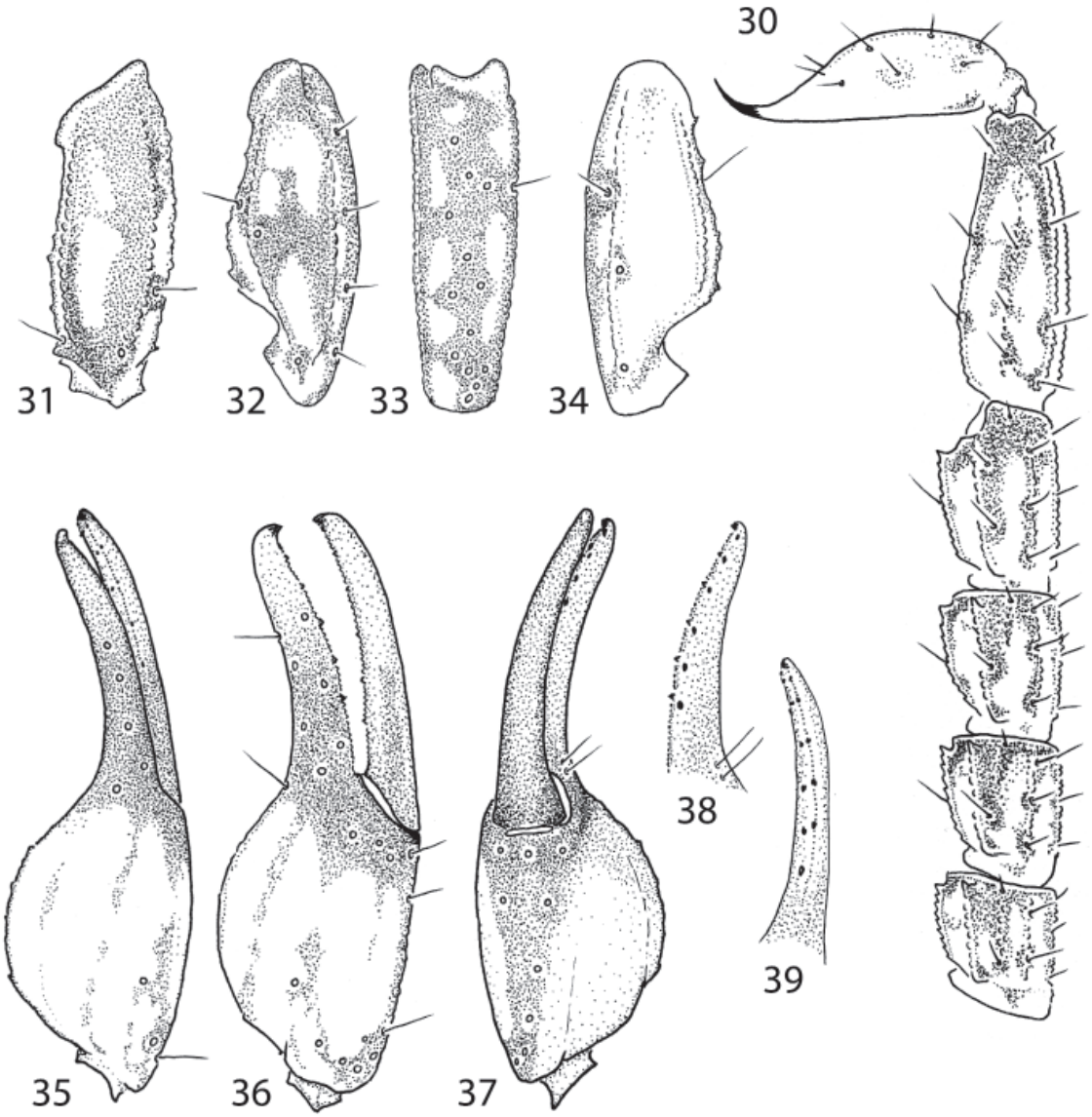
Figures 6–15. Morphology of *Vaejovis sierrae* sp. nov., based on male holotype. **6)** Lateral view of metasoma and telson. **7)** Right pedipalp femur, dorsal. **8)** Right pedipalp patella, dorsal. **9)** Right pedipalp patella, external. **10)** Right pedipalp patella, ventral. **11)** Right pedipalp chela, dorsal. **12)** Right pedipalp chela, external. **13)** Right pedipalp chela, ventral. **14**) Apposable dentate margin of chela fixed finger. **15**) Apposable dentate margin of chela movable finger.



Figures 16–25. Hemispermatophores of *Vaejovis sierrae* sp. nov. and *V. mcwesti* sp. nov. **16–20**, Right hemispermatophore of *V. sierrae*: **16)** dorsal surface of hemispermatophore; **17)** ectal view of midsection; **18)** enlarged view of hooks; **19**) ectoventral aspect of capsular disk; **20)** ventral surface of hemispermatophore. **21–25**, Right hemispermatophore of *V. mcwesti*: **21)** dorsal surface of hemispermatophore; **22)** ectal view of midsection; **23)** enlarged view of hooks; **24)** ectoventral aspect of capsular disk; **25)** ventral surface of hemispermatophore.



Figures 26–29. *Vaejovis mcwesti* sp. nov., from Hwy 36 near Santiago Papasquiaro, Durango, Mexico. **26)** Dorsal aspect, male holotype. **27)** Ventral aspect, male holotype. **28)** Dorsal aspect, female paratype. **29)** Ventral aspect, female paratype.



Figures 30–39. Morphology of *Vaejovis mcwesti* sp. nov., based on male holotype. **30**) Lateral view of metasoma and telson. **31)** Right pedipalp femur, dorsal. **32)** Right pedipalp patella, dorsal. **33)** Right pedipalp patella, external. **34)** Right pedipalp patella, ventral. **35)** Right pedipalp chela, dorsal. **36)** Right pedipalp chela, external. **37)** Right pedipalp chela, ventral. **38**) Apposable dentate margin of chela fixed finger. **39**) Apposable dentate margin of chela movable finger.