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A NEW SPECIES OF THE GENUS *VAEJOVIS* (SCORPIONES, VAEJOVIDAE) ENDEMIC TO THE BALSAS BASIN OF MICHOACAN, MEXICO

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ABSTRACT. A unique new species of the genus *Vaejovis* is described: *V. cisnerosi* from deciduous scrub forest in the Balsas Basin in Michoacan state, Mexico. Morphological characters, including the hemispermatophore of the holotype male, are illustrated. The closest relative of *V. cisnerosi* within the genus is unknown, but hemispermatophore morphology, tarsal setation, and trichobothrial patterns suggest close ties with the *V. eusthenura*, *V. intrepidus* and *V. punctipalpi* groups.

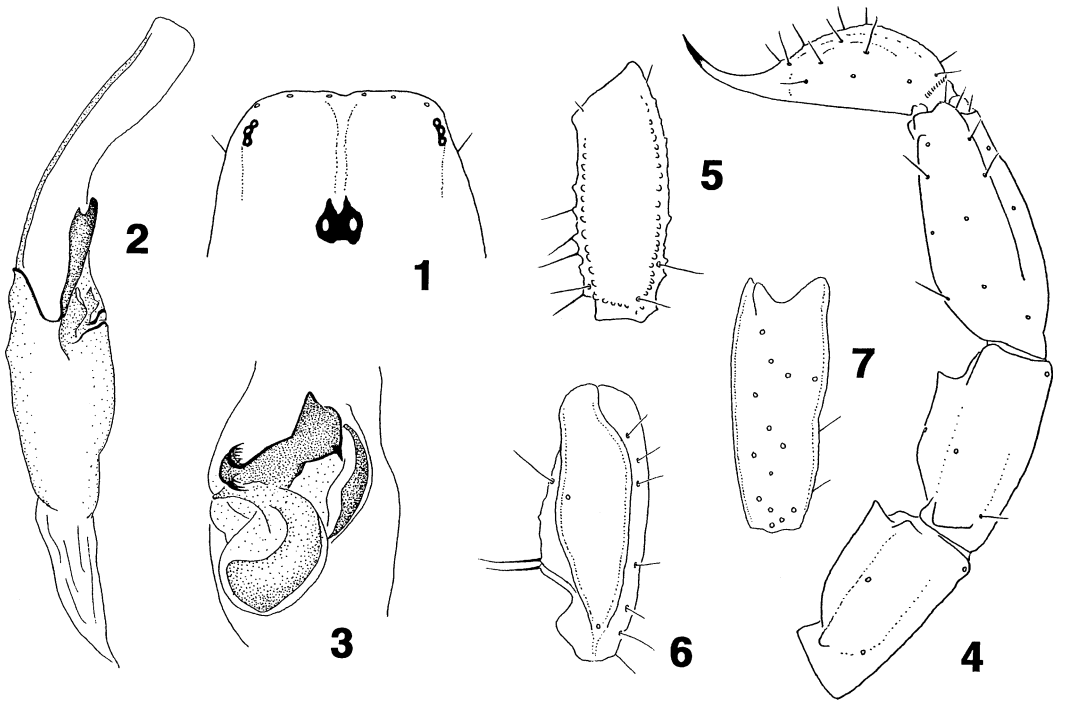
Keywords: Scorpion, *Vaejovis*, taxonomy, Mexico

The Balsas-Tepalcatepec Basin is a distinct structural depression in southern Mexico that extends in a west-northwest to east-southeast direction. Comprising the lower parts of the Balsas river basin, it occupies a large area inside Michoacan and small portions of adjacent Guerrero and Jalisco. In Guerrero it lies near the boundaries with Oaxaca, Puebla and Morelos, and in Michoacan it is a large valley in which the elevation ranges from 200–700 m (Toledo 1982). The Balsas-Tepalcatepec region has experienced a complex geological history and exhibits high levels of endemism in both plants and animals. Among insects, 11 endemic species of butterflies of the family Papilionidae are known (Llorente-Bousquets & Luis-Martínez 1993), and the bee genus *Loxoptilus* is endemic to this region and the coast of Nayarit (Ayala et al. 1993). In birds, although the deciduous scrub forest is not especially rich in diversity, there are many endemic species (Challenger 1998). In arachnids (including scorpions), Robles Gil et al. (1993) recorded 311 species from the subhumid forests of the Pacific, representing fairly high diversity. Scorpions, because of their antiquity and poor vagility, can be considered excellent indicators of the presence of true biogeographical barriers and can be used to help delimit boundaries of biogeographical areas.

Vaejovis is the most diverse genus of scorpions in North America. Sissom (2000) listed 66 described species in a recent world catalog. Six additional species have been described since the appearance of the catalog (Capes 2001; Hendrixson 2001; Hendrixson & Sissom 2001; Armas & Martín Frías 2001), and herein we report on a new species from the Balsas Basin of Michoacan. Seven other species of *Vaejovis* have previously been recorded from the state of Michoacan (Beutelspacher 2000; Ponce & Beutelspacher 2001).

METHODS

Terminology for general morphology conforms to Stahnke (1970), except for trichobothrial patterns (following Vachon 1974), carinal nomenclature (following Francke 1977), and hemispermatophore morphology (following Lamoral 1979 and Sissom 1991). Hemispermatophores from a specimen were dissected by means of an incision in the pleura of the right side of the mesosoma. The hemispermatophores were cut at their connection with the genital opercula, allowing both hemispermatophores (with their paraxial organs intact) to remain united during removal. The right hemispermatophore was subsequently detached and prepared for further study in clove oil as described by Sissom (1990); both hemispermatophores were preserved in 80



Figs. 1–7.—Morphology of the holotype male of *Vaejovis cisnerosi*: 1. Dorsal view of carapace; 2. Dorsal view of right hemispermatophore; 3. Ventral view of right hemispermatophore, showing capsular region; 4. Lateral view of metasomal segments III-V and telson; 5. Dorsal view of pedipalp femur; 6. Dorsal view of pedipalp patella; 7. External view of pedipalp patella.

percent ethyl alcohol and stored in shell vials with the specimen.

Family Vaejovidae Thorell 1876
Genus *Vaejovis* C. L. Koch 1836
Vaejovis cisnerosi new species
(Figs. 1–14)

Type material.—Holotype male taken from Churumuco, Michoacan, Mexico (18°40′15″N, 101°38′39″W), 7 January 2000, J. Ponce (deposited in the Colección Nacional de Arácnidos del Instituto de Biología de la Universidad Nacional Autónoma de México). Paratypes: 1 male, same data as holotype; 1 female, Churumuco, 11 November 2000, R. Moreno; 1 subadult male, 1 juvenile male, Churumuco, 9 September 2000, J. Ponce; 1 male, 1 female, Cerro de Turitzio (18°31′41″N, 100°55′27″W), Arúa, Mpio. de Huetamo, Michoacan, 9 September 2000, R. Moreno, R. Cancino; 1 female, El Carrizal, Mpio. de Carácuaro (19°09′00″N, 101°06′19″ W), July 2000, E. Miranda; all paratypes deposited in the Universidad de Michoacán, Morelia.

Etymology.—The specific name is a patronym honoring the memory of Sócrates Cisneros Paz, biologist and ecologist at Michoacan University, who dedicated a great part of his life to the training of biologists and entomologists and founded the university's laboratory of entomology.

Diagnosis.—*Vaejovis cisnerosi* is very unique in morphology, rendering its placement in an established species group within the genus difficult. *Vaejovis cisnerosi* is unlike all other species of *Vaejovis* in that the carinae of the dorsal and lateral surfaces of the metasoma are greatly reduced in strength (mostly obsolete) and completely smooth. In addition, the metasomal setation is highly reduced (see description below), giving it the lowest setal counts of any species in the genus. These features are autapomorphic.

The hemispermatophore of *V. cisnerosi* is quite similar to those of the species of the *V.*

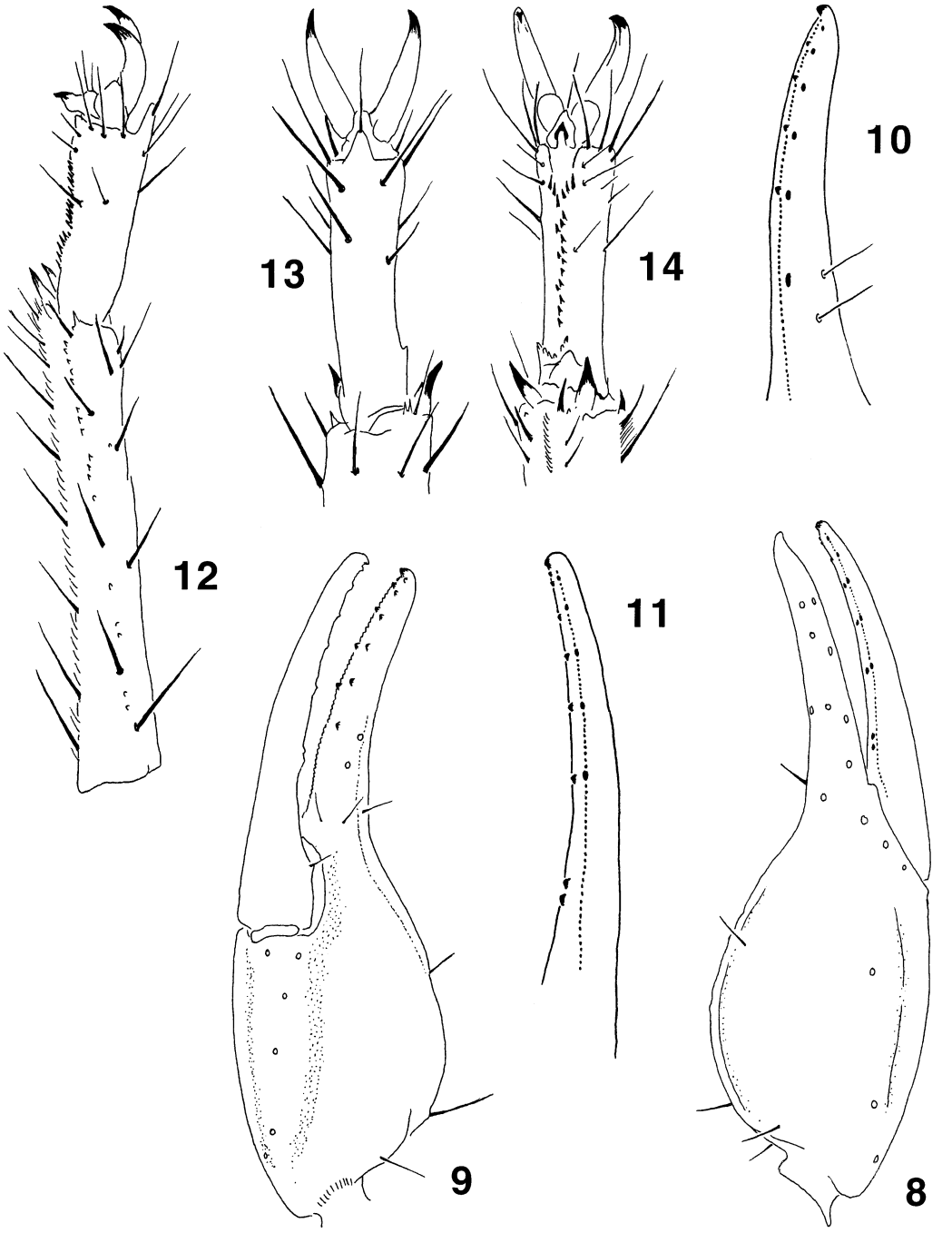
Table 1.—Measurements (in mm) of the type series of *Vaejovis cisnerosi*, new species. L = length, W = width, D = depth, L-R = left-right.

	Churumuco Holotype Male	Churumuco Paratype Female	Churumuco Paratype Male	Turitzio Paratype Female	Carrizal Medida Paratype Female
Total L	57.35	65.15	44.30	65.00	49.10
Carapace L	6.05	7.45	5.05	7.05	5.65
Mesosoma L	19.45	20.10	12.05	19.40	14.05
Metasoma L	31.85	37.60	27.20	38.55	29.40
Metasoma I L/W	3.65/3.70	4.35/4.55	3.20/3.25	4.65/4.85	3.45/3.70
Metasoma II L/W	4.35/3.65	5.30/4.45	3.65/3.15	5.15/4.60	3.50/3/65
Metasoma III L/W	4.40/3.60	5.30/4.30	4.00/3.10	5.65/4.55	4.00/3.10
Metasoma IV L/W	5.55/3.50	6.40/4.20	4.90/3.05	6.80/4.35	4.90/3.05
Metasoma V L/W	7.25/3.30	8.25/3.90	5.95/2.95	8.45/4.30	5.95/3.00
Telson L	6.65	8.00	5.50	7.85	7.60
Vesicle					
L	4.00	5.40	3.55	5.25	5.55
W	2.45	3.35	2.20	3.30	2.20
D	2.10	2.85	1.70	2.70	1.75
Aculeus L	2.65	2.60	1.95	2.60	2.05
Pedipalp L	19.55	24.05	17.15	23.9	18.40
Femur L/W	4.95/1.75	6.20/2.10	4.30/1.50	6.05/2.15	4.40/1.65
Patella L/W	5.10/2.05	6.30/2.20	4.60/1.55	6.70/2.45	5.20/1.75
Chela					
L	9.50	11.55	8.25	11.15	8.80
W	2.80	3.30	2.30	3.45	2.30
D	3.60	4.05	2.95	4.10	1.85
Movable Finger L	5.80	7.30	4.95	7.25	5.30
Fixed Finger L	4.15	5.35	3.65	5.40	4.05
Pectinal Teeth (L-R)	21-21	21-21	21-21	20-20	21-20

eusthenura, *V. intrepidus* and V. *punctipalpi* species groups. There is a broad flange along the ental margin of the distal lamina, and the ental process of the inner capsular lobe bears a series of hooklets (Sissom 1991). The position of trichobothria *ib* and *it* on the pedipalp chela fixed finger (displaced to near the 6th inner accessory denticle of the primary denticle row) and the possession of only five subrows of denticles on the chela fixed finger also suggest relationship with those groups. Finally, the ventromedian spinule row of the leg tarsi are flanked distally by two or more pairs of larger spinules, as in the aforementioned groups.

The reduction of the carinae of the pedipalps and the absence of ventral carinae on the metasoma place the species closer to the *eusthenura* group (e.g. in southern Mexico, this would include *Vaejovis punctatus* Karsch 1879 and its relatives); on the other hand, the reduction of the metasomal setation and the dorsoventral compression of the metasoma are similar to the conditions seen in the *intrepidus* species group.

Description.—Based on adult males; where different, characteristics of females are indicated. Total length: adult males 44.3–57.4 mm, adult females 49.1–65.2 mm. Complete measurements of two males and three females are included in Table 1. *Coloration (in alcohol):* Base color of carapace and tergites yellow. Dorsal aspect of prosoma and mesosoma with diffuse dusky markings. Legs, vesicle and ventral aspect immaculate yellowish. Chela of pedipalps yellow, with the fingers orange brown and the palm with faint lines of pigment that indicate the positions of obsolete dorsal and external carinae. *Prosoma:* Carapace (Fig. 1) with anterior margin bearing three pairs of setae; anterior margin slightly emarginate, median notch weak and shallow.



Figs. 8–14.—Morphology of the holotype male of *Vaejovis cisnerosi*: 8. Dorsal view of pedipalp chela; 9. Proventral view of pedipalp chela; 10. Pedipalp chela fixed finger, showing dentition pattern and position of trichobothria *ib* and *it*; 11. Pedipalp chela movable finger, showing dentition pattern; 12. Left leg III, retrolateral view; 13. Left leg III, superior (dorsal) view; 14. Left leg III, ventral view.

Surface almost completely smooth (a few scattered granules are present). *Mesosoma:* Median carina on all tergites weak or obsolete; all tergites smooth. Tergite VII with four weak lateral carinae on the posterior half; median carina very weak or obsolete. Pectinal tooth count 20–22 in males and 20–21 in females. Sternites I-VII acarinate, with setae along their margins. *Hemispermatophore* (Figs. 2–3): Distal lamina slightly wider at the distal end; ental margin of distal lamina with a broad flange, this partitioned at its distal edge (as viewed from ental aspect). Flange length (as measured from base of dorsal trough margin) approximately 40% of distal lamina length. Ental process of inner capsular lobe (= sperm plug, *sensu* Sissom & Stockwell 1991) with series of hooklets. *Metasoma (Fig. 4):* Segments I–IV with the dorsolateral and lateral supramedian carinae moderate and smooth, ending in an enlarged subspinoid denticle; all other keels obsolete. Intercarinal spaces smooth. Setal counts on segments I–IV: dorsolaterals, 0/0:0/0:0/0:1/1; lateral supramedians, 0/0:1/1:1/1:1/1; lateral inframedians, 0/0:0/0:0/0:0/0; ventrolaterals 0-1/0-1:0-1/0-1:0-1/0-1:0-1/0-1; ventral submedians, 1/1:1/1:1/1:1/1. Segment V: Dorsolateral carinae moderate, smooth anteriorly, slightly granular on posterior third. Lateromedian carina obsolete. Ventrolateral and ventromedian carinae weak and smooth anteriorly, moderate with distinct granules on posterior third. Intercarinal spaces smooth. Metasoma V setal counts: dorsolaterals, 4/4; lateromedians, 2/2; ventrolaterals, 3/3; ventromedians, 3/3. The ratio of segment III length/width 1.22–1.23 in males (n = 2) and 1.24–1.29 in females (n = 3); of segment V length/width 2.12–2.20 (n = 2) in males and 1.97–2.02 in females (n = 3). *Telson* (Fig. 4): Ventral surface of the vesicle completely smooth, with 9 pairs of setae. *Pedipalp:* Trichobothrial pattern type C, orthobothriotaxic. Femur (Fig. 5): Carinae moderate and irregularly granulose. Internal face with scattered granules, these irregular in size and form. Patella (Figs. 6–7): Dorsointernal and ventrointernal carinae smooth to feebly granular; dorsoexternal and ventroexternal carinae completely smooth. Internal face of patella with an oblique, slightly crenulate keel, restricted to basal half. Dorsal and external surfaces smooth. Chela (Figs. 8–11): acarinate, hand moderately swollen. Primary denticle row of fixed finger (Fig. 10) divided into five subrows by four enlarged primary row denticles; denticle subrows flanked medially by six inner accessory granules. Movable finger (Fig. 11) with six subrows and eight inner accessory granules (basalmost usually doubled). Ratio of chela length/width 3.39–3.90 in males (n = 2), 3.23–3.83 in females (n = 3); fixed finger length/carapace length 0.69–0.72 for males (n = 2), 0.72–0.77 in females (n = 3); pedipalp femur length/carapace length 0.82–0.85 for males (n = 2), 0.78–0.86 in females (n = 3). *Legs (Figs. 12–14):* Basitarsus (Fig. 12) with well developed retrosuperior, retroventral, and ventral longitudinal spinule rows. Regularly-spaced setae interspersed along spinule rows as in Fig. 12. Telotarsus: Ventromedian spinule row terminating distally between two to three pairs of larger spinules. Setation as in Figs. 13, 14.

Variation.—In males, pectinal tooth counts were as follows: one comb with 20 teeth, five with 21 teeth, and two combs with 22 teeth. In females, the counts were: 3 combs with 20 teeth and 3 combs with 21 teeth. The dentition of the pedipalp chela fingers was consistent in the number of subrows of denticles and the number of inner accessory denticles on the fixed finger. On the movable finger, however, the number of inner accessory denticles exhibited slight variation. Unique among vaejovids (except some *Serradigitus* spp.), which normally have six or seven inner accessory denticles, this species exhibited doubling of the basalmost denticles, yielding a count of eight. On one individual, the movable finger had the basalmost inner accessory denticle tripled, giving a total count of nine. The females are larger than the males in total length and more robust.

Natural history.—*Vaejovis cisnerosi* is an uncommon species that inhabits deciduous tropical scrub forest. It is found on more or less sandy soils or other soils of smooth texture in open areas, where it digs burrows 15–20 cm deep with circular entrances. Most of the specimens were collected near their burrow entrances. *Vaejovis cisnerosi* coexists with other vaejovids, an undescribed species of *Diplocentrus* Peters 1861 (Diplocentridae) and *Centruroides limpidus* (Karsh 1879) (Buthidae); the latter is the numerically dominant species and has been observed feeding on *V. cisnerosi*.

Distribution.—*Vaejovis cisnerosi* is known from three localities of the Balsas Basin, all in the state of Michoacan.

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