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SCORPIONS OF THE GENUS *PARUROCTONUS* FROM NEW MEXICO AND TEXAS (SCORPIONES, VAEJOVIDAE)

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ABSTRACT

The distribution of *Paruroctonus gracilior* (Hoffmann) and *P. utahensis* (Williams) in New Mexico and Texas is confirmed and new state records of both are established. *P. aquilonalis* (Stahnke) is established as a junior synonym of *P. boreus* (Girard), and state records of both the junior and senior synonyms are considered to be based on misidentifications. Two new species of the genus are described: *P. williamsi* from the Big Bend region in Texas and *P. pecos* from sand dunes in southeastern New Mexico.

INTRODUCTION

The genus *Paruroctonus* Werner, 1934, occurs from southern Canada, across the western United States and south into Mexico. Throughout this range 23 nominal species have been recognized, and four species have been reported from New Mexico and Texas. There has been considerable confusion, however, concerning the taxonomic status of populations from New Mexico and Texas. Some of the confusion is the result of records published before the genus was widely recognized as a valid taxon, additional confusion is due to erroneous identifications, and finally the inadequate description of at least one species has also contributed significantly.

This contribution, based on the study of thousands of specimens representing all nominal taxa of the genus *Paruroctonus* described to date, aims to clarify the taxonomic status of populations from New Mexico and Texas. One nominal species is relegated to synonymy and state records of both the senior and junior synonym are established as misidentifications. Distribution records of two species are confirmed and expanded, and two new species are described.

Paruroctonus boreus (Girard, 1854)

Type data.—Type specimen of uncertain sex from the valley of the Great Salt Lake, Utah, collected by Howard Stansbury. Presumed still to be deposited in the United States National Museum (Gertsch and Soleglad 1966); not examined.

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Remarks.—This species has the northernmost distribution of the genus. Centered in the Great Basin Desert of North America, it extends northward into British Columbia, Alberta, and possibly Saskatchewan in Canada; eastward to North Dakota, South Dakota, and Nebraska; westward to Washington, Oregon, and California, and southward into northern Arizona and southwestern Colorado in the United States.

One immature individual has been reported from Eagle Pass, Maverick Co., Texas, by Girard (1854). We have not seen any *P. boreus* from Texas, and consider this record a misidentification. (It could be *Vaejovis coahuilae* Williams, which is commonly found in the area and has color markings reminescent of immature *P. boreus*.)

Paruroctonus boreus was reported from White Sands National Monument, Otero and Dona Ana counties, New Mexico, by Bugbee (1942). We have not seen any specimens referable to *P. boreus* from New Mexico; samples from White Sands National Monument belong to *Paruroctonus utahensis* (Williams), which is discussed below. Therefore, we consider Bugbee's report of *P. boreus* from New Mexico to be based on a misidentification.

The presence of *P. boreus* in northwestern New Mexico is very likely however, especially in San Juan and McKinley counties. It has been found in Apache Co., Arizona, Montezuma Co., Colorado, and San Juan Co., Utah, which are three of the counties (and states) adjoining each other at Four Corners.

Paruroctonus aquilonalis (Stahnke, 1940)

Type data.—Holotype male from 30 miles south of the Grand Canyon, Arizona, 8 August 1938 (Kay Anderson). Deposited in the collection of H. L. Stahnke; examined.

Remarks.—This nominal taxon, originally described from northern Arizona, has caused considerable taxonomic confusion over the years. The original description (Stahnke 1940: 101), a short excerpt from a dissertation (Stahnke 1939), reads as follows:

> "*Vejovis aquilonalis*. First segment of cauda has no distinct, granular inferior keels. Carapace shorter than fifth caudal segment and slightly shorter than movable finger of pedipalp. Dorsum of a uniform orange-brown color. The specimen, a male, was taken 37 miles south of the Grand Canyon on highway 64."

The discrepancy in the type locality data seems to be a typographical error, for the label with the holotype clearly reads "30 mi. South." According to Stahnke (1939), *P. aquilonalis* differs from *P. boreus* in two characters: the relative proportions of the carapace and movable finger of the pedipalps and in color.

While Stahnke (1939, 1940) clearly indicates that in *P. aquilonalis* the carapace is slightly shorter than the movable finger of the pedipalps, the measurements he reported contradict this. In Stahnke's dissertation (1939:75), the measurements given are: carapace length 4.4 mm , movable finger length 4.3 mm. This indicates that the carapace is actually slightly longer, not shorter, than the movable finger. Our measurements of the holotype (Table 1) indicate that these two structures are essentially equal in length. In addition, the ratio carapace length/movable finger length is quite variable in many species of *Paruroctonus*. Therefore, we do not consider this ratio to be a good diagnostic indicator of species differences.

With respect to coloration, *P. boreus* has been characterized as being pale yellow to orange-brown with more or less developed dusky or black pattern on the carapace, mesosoma, and ventral aspect of the metasoma. *P. aquilonalis* has been characterized as

Table 1.–Measurements (in millimeters) of *Paruroctonus aquilonalis* (Stahnke, 1940) [= *P. boreus* (Girard 1854)], *Paruroctonus williamsi*, n. sp., and *Paruroctonus pecos*, n. sp.

	P. aquilonalis holotype ♂	*P. williamsi* holotype ♂	*P. williamsi* paratype ♀	*P. pecos* holotype ♂	*P. pecos* paratype ♀
Total length	34.55	33.79	33.46	34.44	34.81
Carapace length	4.20	4.29	4.58	4.15	4.57
Mesosoma length	9.25	9.01	9.56	9.19	10.78
Metasoma length	21.10	15.94	14.57	16.15	14.80
I length/width	2.20/2.15	2.10/2.15	1.73/2.25	2.10/2.25	1.98/2.40
II length/width	2.60/2.05	2.43/2.03	2.30/2.05	2.53/2.13	2.30/2.18
III length/width	2.90/1.95	2.71/1.91	2.50/1.92	2.93/2.02	2.49/2.08
IV length/width	3.60/1.85	3.60/1.76	3.34/1.89	3.35/1.84	3.33/1.94
V length/width	5.20/1.70	5.10/1.64	4.70/1.78	5.24/1.52	4.70/1.61
Telson length	4.60	4.55	4.75	4.95	4.66
vesicle width/depth	1.80/1.40	1.37/1.25	1.71/1.36	1.55/1.24	1.56/1.44
aculeus length		1.65	2.05	1.85	2.08
Pedipalp length	14.50	13.05	13.59	13.16	13.38
femur length	3.80	3.28	3.26	3.20	3.15
femur width	1.15	1.15	1.28	1.05	1.30
femur depth		1.20	1.25	1.00	1.05
tibia length	3.90	3.60	3.85	3.60	3.78
tibia width	1.40	1.51	1.74	1.69	1.69
tibia depth		1.45	1.54	1.47	1.41
chela length	6.80	6.17	6.48	6.36	6.45
chela width	1.90	2.29	2.09	2.19	2.13
chela depth	2.60	2.55	2.45	2.60	2.56
movable finger length	4.25	3.64	3.66	3.74	3.74
fixed finger length	3.30	2.63	2.71	2.57	2.69
Chelicera length		2.24	2.15	1.99	2.35
chela length/width		1.35/1.09	1.35/1.25	1.15/1.05	1.50/1.20
movable finger length		1.29	1.50	1.20	1.40
fixed finger length		0.89	0.80	0.84	0.85
Pectinal tooth count	29-29	22-21	14-14	21-20	14-13

being uniformly orange-brown without variegations. First of all, the holotype of *P. aquilonalis* is in such poor state of preservation (it appears to have been dried on more than one occasion), that it is impossible to determine the original color and pattern (if any). Secondly, the supposed differences in color disappear when large samples are analyzed. We have examined several samples from northern Arizona and southern Utah with considerable variability in the development of dusky markings: a few specimens have a distinct *P. boreus* pattern, others are unvariegated as in *P. aquilonalis*, and the majority present a range of variability that spans the two extremes. Therefore, this character is unreliable and cannot be used to separate these two nominal taxa.

Detailed comparisons of numerous samples from northern Arizona and southern Utah indicate that two closely related species of *Paruroctonus* inhabit the area. One, with variable color pattern, and with 6-7 pairs of setae along the ventrolateral keels of metasomal segment V represents *P. boreus*. The other, always immaculate, and with 9-11 pairs of setae along the ventrolateral keels of segment V represents *P. utahensis*. The holotype of *P. aquilonalis* clearly belongs to the first species; therefore we propose the following synonymy: *P. boreus* (Girard, 1854) = *P. aquilonalis* (Stahnke, 1940).

Published records of *P. boreus*, under the name *P. aquilonalis*, from New Mexico, Texas, and Chihuahua (Gertsch and Soleglad 1966, Muma 1975, Diaz Nájera 1975, Rowland and Reddel 1976, Riddle *et al.* 1976, Riddle and Pugash 1976, Riddle 1978) are all referable to *P. utahensis*.

Paruroctonus utahensis (Williams, 1968)
Figs. 1-6, 29-30

Type data.—Holotype male from 2 mi. NE Bluff, San Juan Co., Utah, 14 July 1967 (S. C. Williams, M. A. Cazier, J. Davidson). Deposited at the California Academy of Sciences, San Francisco.

Distribution.—USA: Arizona, Utah, New Mexico, Texas. MEXICO: Chihuahua. For distribution in Texas and New Mexico, refer to Fig. 35.

Diagnosis.—Adults 35-45 mm in length. Color pale yellow, always immaculate. Dorsolateral carinae on metasomal segments I-IV well developed, serrate, strongly convergent posteriorly; setation 0:1:1:2. Ventral submedian keels on I obsolete; on II-III poorly developed, smooth; on IV moderately developed, smooth to crenulate; setation typically 3:4:4:5. Ventrolateral keels on segment V bearing 9-11 pair of setae. Chelicerae with subdistal and distal teeth of movable finger subequal in length, apposed (Figs. 29-30); inferior margin of movable cheliceral finger with 4-5 weak crenulations. All carinae of pedipalp chela well developed, strongly granular; dorsal marginal and ventroexternal carinae with multiple rows of granules (Figs. 1-6). Pectinal tooth count 29-37 in males, 17-22 in females.

Comparisons.—Based on general appearance and setation, *P. utahensis* is most similar to *P. auratus* (Gertsch and Soleglad) and *P. boreus*. It can be distinguished from *P. auratus* by the following characters: (1) *P. utahensis* has 9-11 pair of setae on the ventrolateral carinae of metasomal segment V, while *P. auratus* has 6 pair; (2) pectinal tooth counts for males of *P. utahensis*, although ranging from 29-37, are typically 31-34, while the counts for males of *P. auratus* are lower, being 25-29 (Pectinal tooth counts in females of the two species are quite similar); and (3) *P. utahensis* always lacks nodules at the base of the fixed cheliceral finger, which are present in *P. auratus* (2 nodules in males, 3 in females).

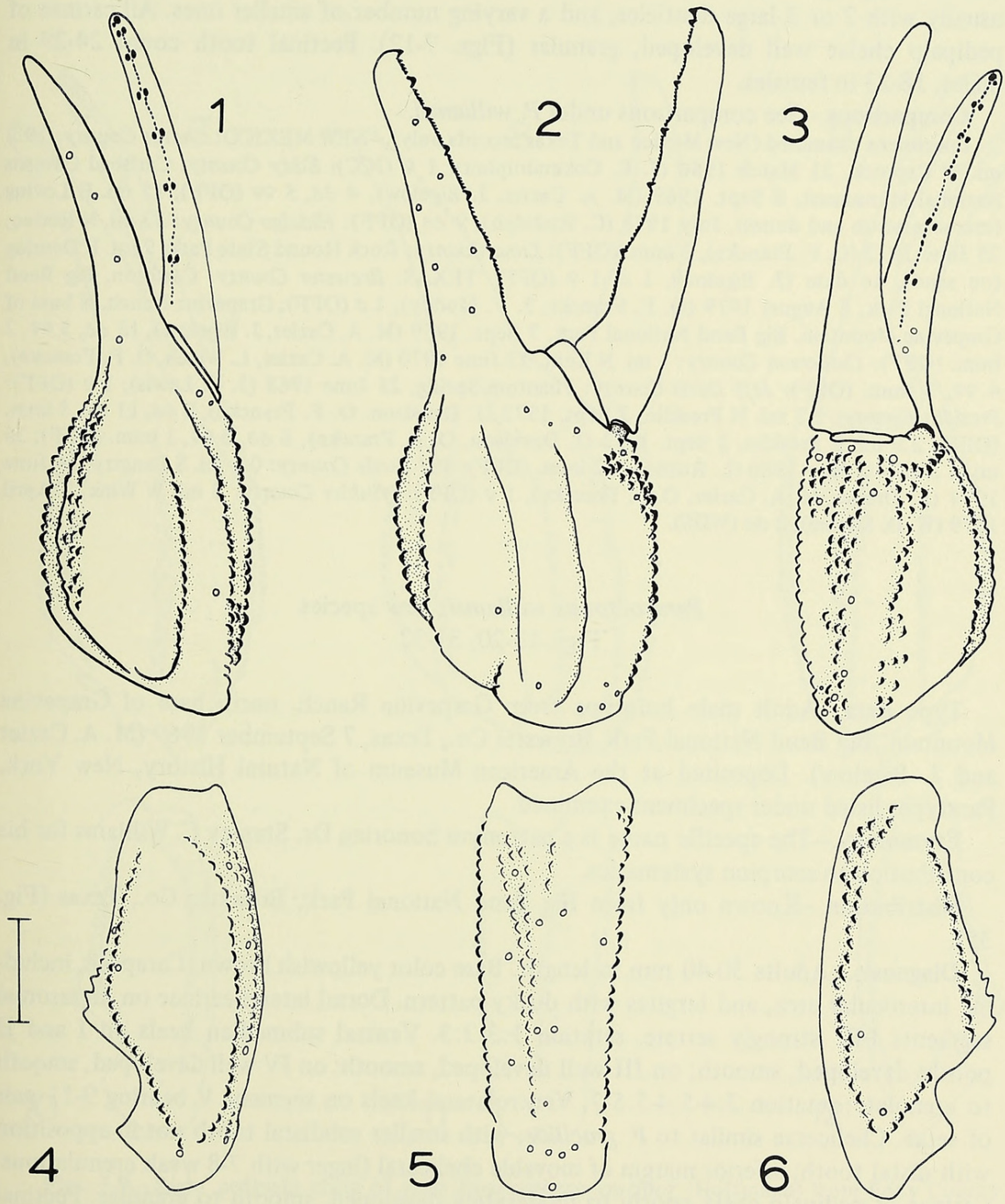
P. utahensis differs from *P. boreus* in the following ways: (1) *P. boreus* has only six setal pairs along the ventrolateral carinae of metasomal segment V; and (2) the ventrolateral carinae of segments II-IV are crenulate to serrate in *P. utahensis*, but smooth in *P. boreus*.

Specimens examined (New Mexico and Texas records only).—NEW MEXICO: *Bernalillo County*: Tijueras Arroyo, just S Albuquerque, 2 June 1974 (W. A. Riddle), 7 ♀♀ (OFF), 14 June 1974, 15 ♂♂ (OFF); Albuquerque (4945 ft.), 5 Sept. 1971 (K. J. Teater), 1 ♂ (OFF); 5 mi. N Interstate Highway 40, Albuquerque, 12 June 1969 (Cazier et al.), 7 ♂♂, 11 ♀♀, 7 imm. (OFF): *Chaves County*: Mescalero Sands, 9 mi. W Caprock, 21 March 1980 (W. D. Sissom), 1 ♂, 7 ♀♀,4 imm. (WDS); 21 March 1980 (J. C. and J. E. Cokendolpher), 4 ♀♀, 5 imm. (JCC); 22 March 1980 (J. C. and J. E. Cokendolpher), 3 ♀♀, 5 imm. (JCC): *Dona Ana County*: Las Cruces (in city), 28 May 1970 (R. L. Smith), 2 imm. (OFF): *Eddy County*: 15 mi. E Loving, July 1978 (C. Rudolph) (oak shinnery), 13 ♂♂, 1 imm., (creosote scrub and dunes) 8 ♂♂, (open dunes) 30 ♂♂, 4 ♀♀ (OFF): *Lincoln County*: Coyote (7000 ft.), no date (G. Vensel), 1 ♂ (OFF): *Otero County*: White Sands National Monument (on consolidated sand at base of dunes), 25 July 1971 (S. Szerlip), 1 ♂, 2 ♀♀ (OFF): *Valencia County*: 20.4 mi. NW Los Lunas on New Mexico Highway 6, 17 June 1970 (M. A. Cazier, L. Welch, O. Francke), 10 ♂♂, 11 ♀♀, 12 imm. (OFF). TEXAS: *El Paso County*: Anthony (on New Mexico boundary of Doña Ana Co.), 19 June 1970 (M. A. Cazier, L. Welch, O. Francke), 263 specimens (OFF), 24 June 1970, over 250 specimens (OFF); 4 June 1974 (M. A. Cazier, L. Draper, O. Francke), 40 ♂♂, 69 ♀♀, 146 imm. (OFF): *Ward County*: Monahans Sand Hills State Park, 8 Sept. 1979 (R. Stewart et al.), 9 ♂♂, 4 ♀♀ (OFF): *Winkler County*: 7.9 mi. NE Kermit, 6 April 1979 (W. D. Sissom), 2 ♀♀, 1 imm. (WDS).

Paruroctonus gracilior (Hoffmann, 1931)
Figs. 7-12, 33-34

Type data.–Male lectotype from Tepezala, Aguascalientes, Mexico (C. C. Hoffmann). Deposited at the American Museum of Natural History, New York; examined.

Distribution.–USA: Arizona, New Mexico, Texas. MEXICO: Coahuila, Aguascalientes. For distribution in Texas and New Mexico, refer to Fig. 35.



Figs. 1-3.–Right pedipalp chela of male *Paruroctonus utahensis* (Williams) from Eddy County, New Mexico, showing tricobothrial pattern: 1, dorsal aspect; 2, external aspect; 3, ventral aspect.

Figs. 4-6.–Right tibia of male *Paruroctonus utahensis* (Williams) from Eddy County, New Mexico, showing tricobothrial pattern: 4, dorsal aspect; 5, external aspect; 6, ventral aspect. Scale = 1.0 mm.

Diagnosis.—Adults 35-45 mm in length. Base color yellow to yellow-brown; interocular area of carapace marked by a dusky triangle; tergites with considerable dusky coloration. Dorsolateral carinae on metasomal segments I-IV well developed, serrate, weakly convergent posteriorly; setation 1:1:1:2. Ventral submedian keels on I obsolete; on II-III poorly developed, smooth; on IV moderately developed, smooth; setation 4:5:5:6-7. Ventrolateral carinae on segment V bearing 9-11 pair of setae. Cheliceral movable finger with smaller subdistal tooth not in apposition with distal tooth (Figs. 33-34); distal tooth of movable finger greatly enlarged, strongly curved inward; inferior margin of movable finger usually with 2 or 3 large denticles, and a varying number of smaller ones. All carinae of pedipalp chelae well developed, granular (Figs. 7-12). Pectinal tooth count 24-29 in males, 18-23 in females.

Comparisons.—See comparisons under *P. williamsi.*

Specimens examined (New Mexico and Texas records only).—NEW MEXICO: *Chaves County*: 19.2 mi. W Caprock, 21 March 1980 (J. E. Cokendolpher), 1 ♀ (JCC): *Eddy County*: Carlsbad Caverns National Monument, 8 Sept. 1969 (M. A. Cazier, J. Bigelow), 4 ♂♂, 5 ♀♀ (OFF); 15 mi. E Loving (creosote scrub and dunes), July 1978 (C. Rudolph), 9 ♂♂ (OFF): *Hidalgo County*: 13 mi. N Rodeo, 25 June 1973 (O. F. Francke), 2 imm. (OFF): *Luna County*: Rock Hound State Park, 9 mi. E Deming (on sand), no date (J. Bigelow), 1 ♂, 1 ♀ (OFF). TEXAS: *Brewster County*: Castolon, Big Bend National Park, 8 August 1979 (O. F. Francke, J. V. Moody), 1 ♂ (OFF); Grapevine Ranch, N base of Grapevine Mountain, Big Bend National Park, 7 Sept. 1969 (M. A. Cazier, J. Bigelow), 15 ♂♂, 3 ♀♀, 2 imm. (OFF): *Culberson County*: 1 mi. N Kent, 23 June 1970 (M. A. Cazier, L. Welch, O. F. Francke), 4 ♀♀, 3 imm. (OFF): *Jeff Davis County*: Phantom Spring, 25 June 1968 (J. C. Lewis), 1 ♀ (OFF): *Presidio County*: 3.3 mi. N Presidio, 2 Sept. 1972 (J. Davidson, O. F. Francke), 8 ♂♂, 11 ♀♀, 3 imm. (OFF); 2.9 mi. E Presidio, 2 Sept. 1972 (J. Davidson, O. F. Francke), 6 ♂♂, 3 ♀♀, 1 imm. (OFF); 36 mi. S Marfa, 2 May 1980 (L. Robbins), 2 imm. (OFF): *Val Verde County*: 0.5 mi. S Langtry, 14 June 1974 (L. Draper, M. A. Cazier, O. F. Francke), 1 ♀ (OFF): *Winkler County*: 3 mi. W Wink, 7 April 1979 (W. D. Sissom), 2 ♂♂ (WDS).

Paruroctonus williamsi, new species
Figs. 13-20, 31-32

Type data.—Adult male holotype from Grapevine Ranch, north base of Grapevine Mountain, Big Bend National Park, Brewster Co., Texas, 7 September 1969 (M. A. Cazier and J. Bigelow). Deposited at the American Museum of Natural History, New York. Paratypes listed under specimens examined.

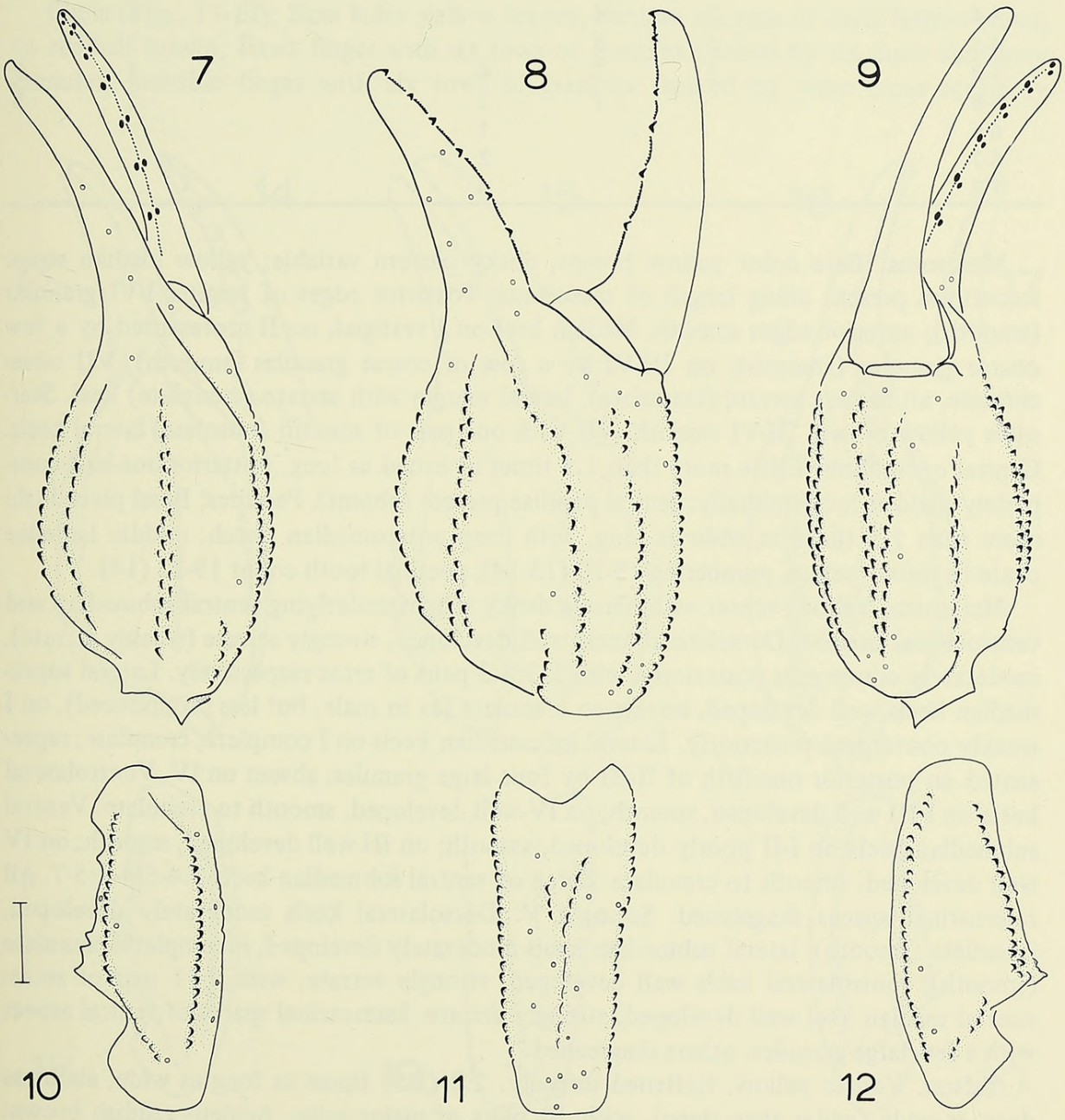
Etymology.—The specific name is a patronym honoring Dr. Stanley C. Williams for his contribution to scorpion systematics.

Distribution.—Known only from Big Bend National Park, Brewster Co., Texas (Fig. 35).

Diagnosis.—Adults 30-40 mm in length. Base color yellowish brown. Carapace, including interocular area, and tergites with dusky pattern. Dorsal lateral carinae on metasomal segments I-IV strongly serrate, setation 1:3:3:3. Ventral submedian keels on I and II poorly developed, smooth; on III well developed, smooth; on IV well developed, smooth to crenulate; setation 3:4-5:4-5:5-7. Ventrolateral keels on segment V bearing 9-11 pair of setae. Chelicerae similar to *P. gracilior*, with smaller subdistal tooth not in apposition with distal tooth; inferior margin of movable cheliceral finger with 7-8 weak crenulations. Carinae of pedipalp chela poorly to moderately developed, smooth to granular. Pectinal tooth count 19-23 in males, 14 in females.

Description.—The following description is based on males; parenthetical statements refer to females. Measurements of holotype and female paratype given in Table 1.

Prosoma. Carapace: Base color yellow brown, mottled with dusky pattern; interocular area same color as adjoining carapace; anterior margin with slight emargination(straight), with eight setae; three pairs lateral eyes; ocular tubercle black, smooth. Anterior median furrow narrow, shallow; central transverse furrow shallow, wide; posterior median furrow deep; posterior lateral furrow shallow, wide, weakly arcuate. Anterior one-half of carapace rather smooth with few coarse granules, posterior one-half with numerous large granules (few, scattered) on areas surrounding furrows. Sternum subpentagonal with deep posteromedial depression; posterior margin strongly notched; slightly wider than long.



Figs. 7-9.–Right pedipalp chela of male *Paruroctonus gracilior* (Hoffmann) from Eddy County, New Mexico, showing tricobothrial pattern: 7, dorsal aspect; 8, external aspect; 9, ventral aspect.

Figs. 10-12.–Right tibia of male *Paruroctonus gracilior* (Hoffmann) from Eddy County, New Mexico, showing tricobothrial pattern: 10, dorsal aspect; 11, external aspect; 12, ventral aspect. Scale = 1.0 mm.

Table 2.—Variability in setation of the ventral submedian keels of segments I-IV in *P. williamsi* and *P. pecos*.

	P. williamsi segments				*P. pecos* segments			
No. Setae	I	II	III	IV	I	II	III	IV
2-3					2			
3-3	10				4			
3-4	3				3			
4-4		7	4		2	10	6	
4-5		5	5			1	3	
5-5		1	3	4			1	3
5-6			1	2			1	8
6-6				1				
6-7				2				
7-7				4				

Mesosoma. Base color yellow brown, dusky pattern variable; yellow median stripe sometimes present along length of mesosoma. Posterior edges of tergites I-VI granular (smooth), anterior edges smooth. Median keel on I vestigial, on II represented by a few coarse granules (smooth), on III-VI by a row of coarse granules (smooth); VII tetracarinate, all carinae serrate (crenulate), lateral margin with serrate (crenulate) keel. Sternites yellow brown, III-VI smooth, VII with one pair of smooth (obsolete) lateral keels. Genital operculum: Little more than 1.5 times as broad as long, posterior one-half completely divided longitudinally; genital papillae present (absent). Pectines: Basal piece little more than 1.5 times as wide as long, with deep anteromedian notch; middle lamellae ovate to round, setate, numbering 15-20 (13-14); pectinal tooth count 19-23 (14).

Metasoma. Yellow, venter with narrow dusky stripes underlying ventral submedian and ventrolateral carinae. Dorsolateral keels well developed, strongly serrate (weakly serrate), moderately convergent posteriorly, with 1:3:3:3 pairs of setae respectively. Lateral supramedian keels well developed, serrate to crenulate (as in male, but less pronounced), on I weakly convergent posteriorly. Lateral inframedian keels on I complete, crenulate; represented on posterior one-fifth of II-III by four large granules; absent on IV. Ventrolateral keels on I-III well developed, smooth; on IV well developed, smooth to crenulate. Ventral submedian keels on I-II poorly developed, smooth; on III well developed, smooth; on IV well developed, smooth to crenulate. Setae of ventral submedian keels 3:4-5:4-5:5-7. All intercarinal spaces shagreened. Segment V: Dorsolateral keels moderately developed, crenulate (smooth); lateral submedian keels moderately developed, incomplete, crenulate (smooth); ventrolateral keels well developed, strongly serrate, with 9-11 pair of setae; ventral median keel well developed, strongly serrate. Intercarinal spaces of ventral aspect with a few large granules, others shagreened.

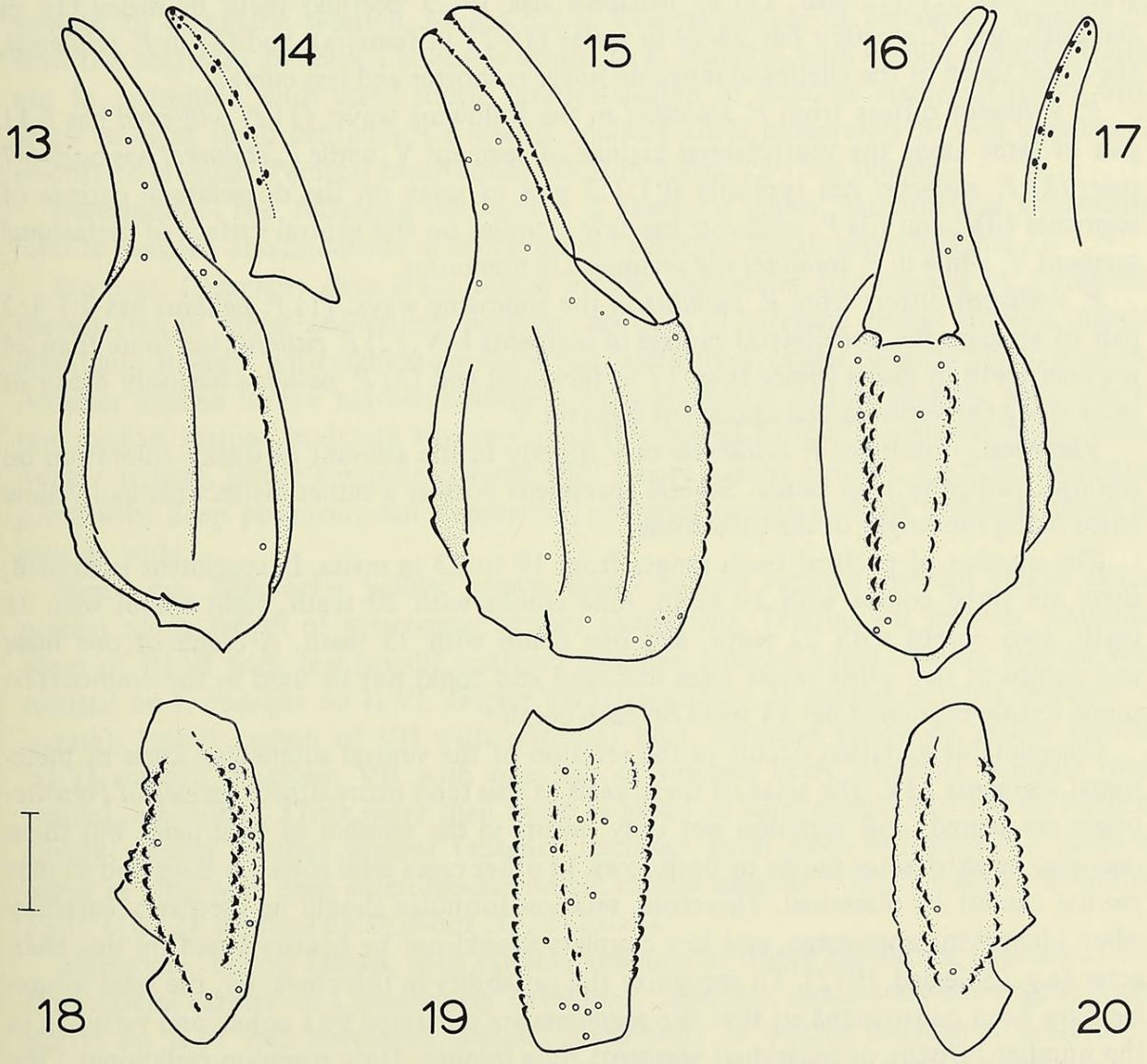
Telson. Vesicle yellow, flattened dorsally, 2.0 (1.5) times as long as wide, about as deep as wide (wider than deep), with 10 pairs of major setae. Aculeus reddish brown, moderately curved, about two-thirds as long as vesicle.

Chelicerae (Figs. 31-32). Creamy yellow, teeth brown. Dentition similar to *P. stahnkei* (Gertsch and Soleglad): Distal and subdistal teeth of movable finger not in apposition, subdistal tooth not quite one-third the length of distal tooth. Inferior margin of movable finger with 7-8 weak crenulations, one or two of these usually larger than others.

Pedipalps. Femur: Base color yellow brown, intercarinal spaces dusky (plain). Dorsointernal keel well developed, granose; ventrointernal keel well developed, weakly serrate (granose); dorsoexternal keel well developed, crenulate (smooth to crenulate); ventroexternal keel represented by three strong granules (smooth). Intercarinal spaces shagreened. Orthobothriotaxia "c" (Vachon 1974).

Tibia (Figs. 18-20): Base color yellow brown, intercarinal spaces dusky. Dorsointernal keel well developed, granular; basal tubercle moderately strong; ventrointernal keel well developed, serrate; dorsoexternal keel moderately developed, crenulate; external face of tibia covered with small granules; ventroexternal keel well developed, crenulate. Intercarinal spaces shagreened. Orthobothriotaxia "C" (Vachon, 1974).

Chela (Figs. 13-17): Base color yellow brown, dentate margins of chela fingers brown to reddish brown; fixed finger with six rows of granules flanked by six inner accessory granules, movable finger with six rows of granules flanked by seven inner accessory



Figs. 13-17.–Right pedipalp chela of male holotype *Paruroctonus williamsi*, new species, showing tricobothrial pattern: 13, dorsal view; 14, dentate margin of movable finger; 15, external view; 16, ventral view; 17, dentate margin of fixed finger.

Figs. 18-20.–Right tibia of male holotype *Paruroctonus williamsi*, new species, showing tricobothrial pattern: 18, dorsal view; 19, external view; 20, ventral view. Scale = 1.0 mm.

granules. Dorsal marginal keel moderately developed, granular to smooth (smooth); dorsal secondary keel moderately developed, smooth; digital keel well developed, smooth; external secondary keel poorly developed, granular to smooth; ventroexternal keel well developed, crenulate to serrate (smooth to crenulate); ventromedian keel moderately developed, crenulate (smooth); ventrointernal keel poorly developed, smooth; dorsointernal keel moderately developed, smooth to granular (smooth). Ratio of chela length to chela width approximately 2.70 in males, 3.10 in females; of fixed finger length to chela length approximately 0.40; of movable finger length to fixed finger length approximately 1.35.

Legs. Yellow, with or without pattern of dusky coloration. Tarsomere I of legs I-III with dorsal row of six to eight stout setae.

Comparisons.—Based on cheliceral dentition, *P. williamsi* is most similar to *P. gracilior, P. stahnkei*, and *P. pallidus*. From *P. gracilior*, it differs in the following ways: (1) *P. williamsi* has 1:3:3:3 pair of setae on metasomal segments I-IV respectively, while *P. gracilior* has 1:1:1:2 pair; (2) *P. williamsi* has 19-23 pectinal teeth in males (14 in females), and *P. gracilior* has 24-29 in males (18-23 in females); and (3) in *P. williamsi*, the distal tooth of the cheliceral movable finger is shorter and less curved.

P. williamsi differs from *P. stahnkei* in the following ways: (1) *P. williamsi* has 9-11 pair of setae along the ventrolateral carinae of segment V, while *P. stahnkei* has only 6-7 pair; (2) *P. stahnkei* has typically 0:1:1:2 pair of setae on the dorsolateral carinae of segments I-IV; and (3) *P. williamsi* has few granules on the ventral surface of metasomal segment V, while in *P. stahnkei* the granules are numerous.

P. williamsi differs from *P. pallidus* in the following ways: (1) *P. pallidus* has 0:1:1:2 pair of setae on the dorsolateral carinae of segments I-IV; (2) *P. pallidus* has more than 24 pectinal teeth in males (more than 17 in females); and (3) *P. pallidus* has only 8 pair of setae along the ventrolateral carinae of segment V.

Variation.—Adults of *P. williamsi* vary slightly in the amount of dusky coloration on the legs, pedipalps, and cauda. Several specimens possess a rather distinct median yellow stripe along the length of the mesosoma.

The number of pectinal teeth ranges from 19 to 23 in males. In specimens examined, there are three combs with 19 teeth, nine combs with 20 teeth, eight combs with 21 teeth, two combs with 22 teeth, and one comb with 23 teeth. A comb of one male and combs of two other males were damaged and could not be used in the counts. The single female examined has 14 teeth on each comb.

Considerable variation occurs in the setation of the ventral submedian keels of metasomal segments I-IV. The setae of these keels of this (and many other) species of *Paruroctonus* are paired, and variation not only occurs in the number of setal pairs, but there may also be extra setae in one or both rows. In other cases setal rows are staggered so that pairing cannot be discerned. Therefore, setation formulae should be used very carefully when identifying specimens, and key couplets should not be heavily based on this character (e.g., Soleglad 1972). To recognize the variability in this character, the setal formulae have been constructed so that the segments are separated by a colon, and variation in the number of pairs of individual segments by a hyphen. Only common variations of the latter are used in the formula.

The setal formula for the ventral submedian keels in *P. williamsi* is 3:4-5:4-5:5-7, showing a high degree of variability in this character for this species. For a more complete analysis consult Table 2.

Specimens examined.—TEXAS: *Brewster Co.*; Grapevine Ranch, north base of Grapevine Mountain, Big Bend National Park, 7 September 1969 (M.A. Cazier and J. Bigelow), holotype ♂, 1 ♀ paratopotype (AMNH), 13 ♂♂ paratopotypes (OFF), 2 ♂♂ paratopotypes (WDS).

Paruroctonus pecos, new species
Figs. 21-28

Type data.–Adult male holotype from 15 mi. E Loving Eddy Co., New Mexico, July 1978 (C. Rudolph). Deposited at the American Museum of Natural History, New York. Paratypes listed under specimens examined.

Etymology.–The specific name is a noun in apposition taken from the Pecos River, which is near the type locality.

Distribution.–Known only from the type locality and the Mescalero Sands Region, Chaves Co., New Mexico (Fig. 35).

Diagnosis.–Length 30-40 mm. Base color yellow brown. Carapace with dusky crescent delineating interocular triangle; tergites with dusky pattern. Dorsolateral carinae on metasomal segment I moderately developed, crenulate; on II-IV well developed, serrate; setation 1:1:1:2. Ventral submedian keels on I very poorly developed, smooth to obsolete; on II-III poorly developed, smooth to obsolete; on IV moderately developed, smooth to crenulate; setation 3-4:4:4-5:5-6. Ventral surface of metasomal segment V with few scattered granules. Chelicerae similar to *P. stahnkei*, with smaller subdistal tooth not in apposition with distal tooth; inferior margin of movable cheliceral finger with seven to eight small denticles. Carinae of pedipalp chela moderately to well developed, smooth to granular. Pectinal tooth count 20-22 in males, 13-15 in females.

Description.–The following description is based on males; parenthetical statements refer to females. Measurements of holotype and paratype female given in Table 1.

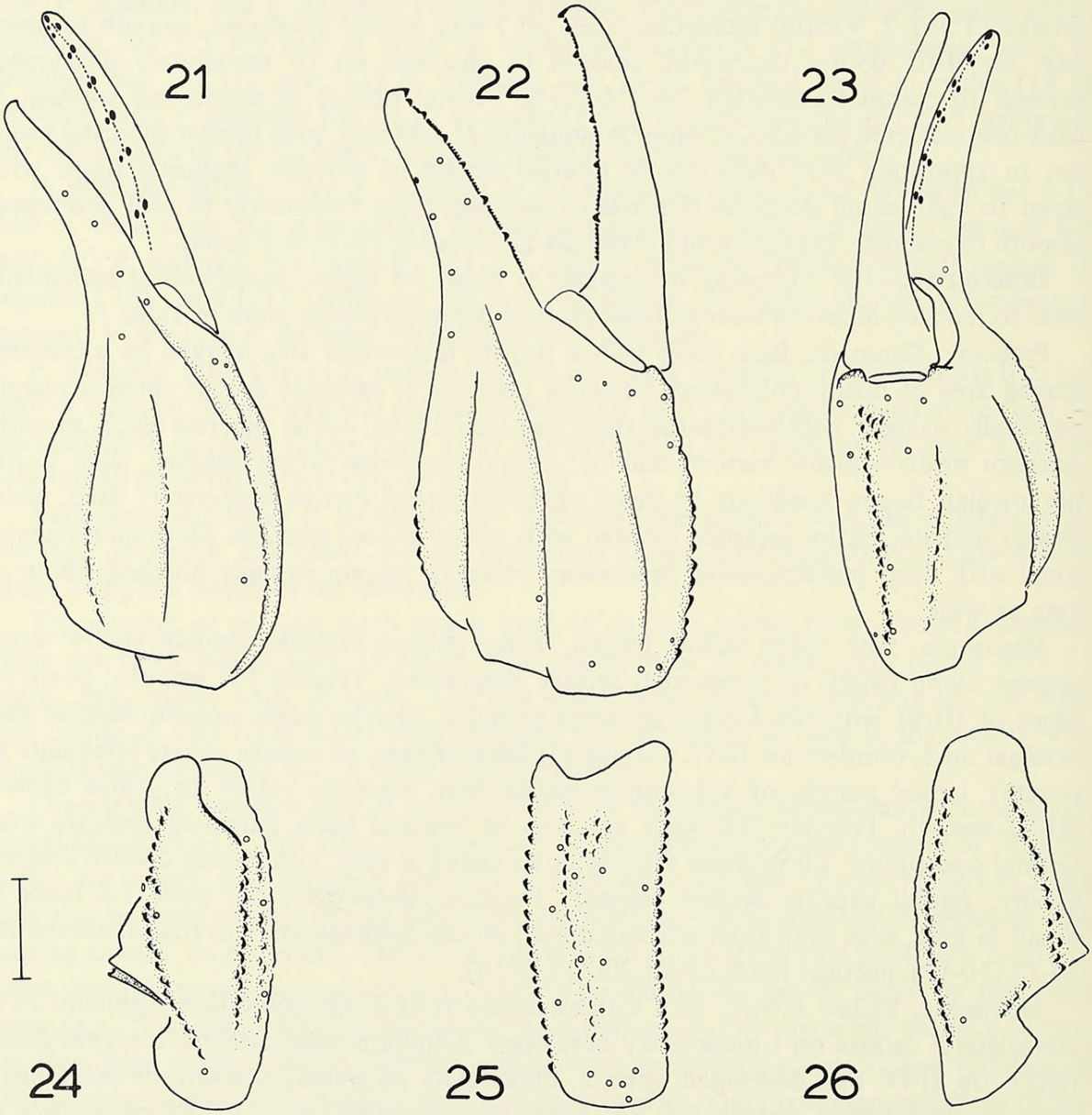
Prosoma. Carapace: Base color yellow brown; interocular area marked by a crescent shaped area of dusky coloration; posterior portions of carapace dusky; anterior margin essentially straight, with eight setae; three pair lateral eyes; ocular tubercle black, smooth. Anterior median furrow narrow, shallow; central transverse furrow shallow, wide; posterior median furrow moderate to deep; posterior lateral furrow moderately deep, wide, weakly arcuate. Entire carapace covered with evenly spaced granules. Sternum subpentagonal with deep posteromedial depression; posterior margin strongly notched; about as long as wide.

Mesosoma. Base color yellow brown, dusky pattern variable; median yellow stripe present along length of mesosoma; surface shagreened. Tergites I-II smooth; posterior edges of III-VI with few (small) scattered granules, anterior edges smooth. Median keel vestigial on I, obsolete on II-VI. Tergite VII tetracarinate, all carinae serrate (crenulate to serrate); lateral margin of VII with crenulate keel. Sternites yellow to yellow brown, III-VI smooth, lustrous; VII with one pair of vestigial keels. Stigmata elongate oval. Genital operculum: Little more than twice as broad as long; completely divided longitudinally; genital papillae present (absent). Pectines: Basal piece not quite 1.5 times as broad as long, with deep anteromedian notch; middle lamellae ovate to round, numbering 15-17 (10-13); pectinal tooth count 20-22 (13-15).

Metasoma. Yellow brown, with variable amounts of dusky coloration. Segments I-IV: Dorsolateral carinae on I moderately developed, crenulate, moderately convergent posteriorly; on II-IV well developed, serrate, moderately to weakly convergent posteriorly; setae on dorsolateral carinae 1:1:1:2. Lateral supramedian keels on I-IV moderately to well developed, crenulate. Lateral inframedian keels on I complete, crenulate; represented on posterior one-fifth of II-III by two to three granules; absent on IV. Ventrolateral keels on I moderately developed, smooth; on II-III well developed, smooth; on IV well developed, smooth to crenulate. Ventral submedian keels on I very poorly developed, absent

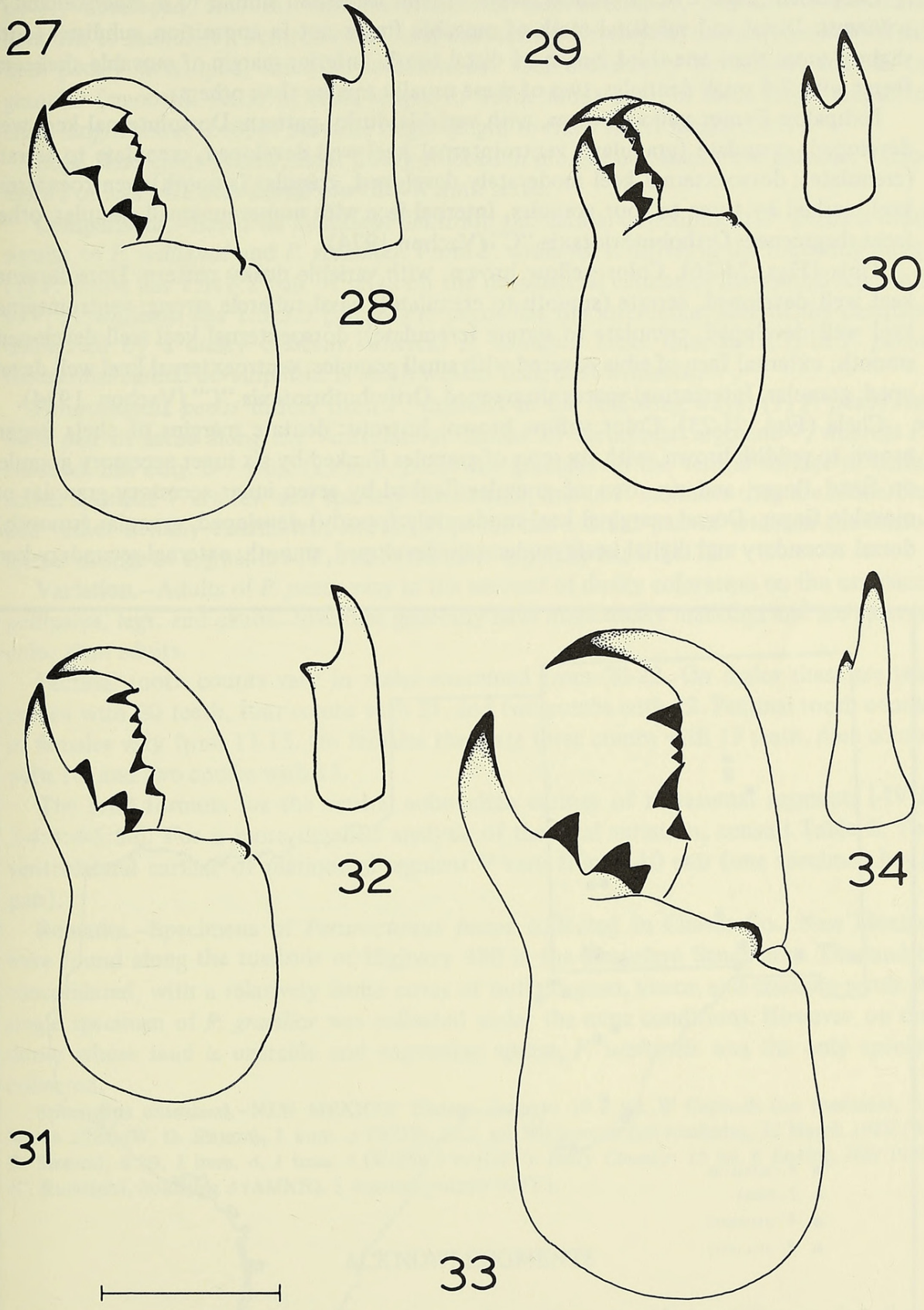
on anterior one-half, smooth on posterior one-half; on II-III poorly developed, smooth; on IV moderately developed, smooth to crenulate; setae on ventral submedian keels 3-4:4:4-5:5-6. All intercarinal spaces shagreened. Segment V: Dorsolateral keels moderately developed, smooth; lateral submedian keels moderately developed, granular, incomplete; ventrolateral keels well developed, serrate, with 9-10 pair of setae; ventromedian keel well developed, serrate. Intercarinal spaces of ventral aspects of V with a few small granules, all other intercarinal spaces shagreened.

Telson. Vesicle yellow brown, flattened dorsally; twice (1.5 times) as long as wide, little wider than deep, with 11 pairs of major setae; subtle subaculear tubercle sometimes present in males. Aculeus reddish brown, moderately curved, about five-eighths as long as vesicle.



Figs. 21-23.–Right pedipalp chela of male holotype *Paruroctonus pecos*, new species, showing trichobothrial pattern: 21, dorsal view; 22, external view; 23, ventral view.

Figs. 24-26.–Right tibia of male holotype *Paruroctonus pecos*, new species, showing tricobothrial pattern: 24, dorsal view; 25, external view; 26, ventral view. Scale = 1.0 mm.



Figs. 27-34.–Right chelicerae of species of *Paruroctonus* in New Mexico and Texas: Figs. 27, 29, 31, 33.–Dorsal views; Figs. 28, 30, 32, 34.–Prolateral views of movable finger; Figs. 27-28: *Paruroctonus pecos*, holotype male; Figs. 29-30: *Paruroctonus utahensis*, male from Eddy County, New Mexico; Figs. 31-32: *Paruroctonus williamsi*, holotype male; Figs. 33-34: *Paruroctonus gracilior*, male from Eddy County, New Mexico. Scale = 1.0 mm.

Chelicerae (Figs. 27-28). Yellow, teeth brown. Dentition similar to *P. stahnkei* and *P. williamsi*: Distal and subdistal teeth of movable finger not in apposition, subdistal tooth slightly more than one-third length of distal tooth. Inferior margin of movable cheliceral finger with 7-8 small denticles, two of these usually smaller than others.

Pedipalps. Femur yellow brown, with variable dusky pattern. Dorsointernal keel well developed, crenulate (granular); ventrointernal keel well developed, crenulate to serrate (crenulate); dorsoexternal keel moderately developed, granular (smooth); ventroexternal keel marked by three to four granules. Internal face with numerous small granules, other faces shagreened. Orthobothriotaxia "C" (Vachon 1974).

Tibia (Figs. 24-26). Color yellow brown, with variable dusky pattern. Dorsointernal keel well developed, serrate (smooth to crenulate); basal tubercle strong; ventrointernal keel well developed, crenulate to serrate (crenulate); dorsoexternal keel well developed, smooth; external face of tibia covered with small granules; ventroexternal keel well developed, granular. Intercarinal spaces shagreened. Orthobothriotaxia "C" (Vachon 1974).

Chela (Figs. 21-23). Color yellow brown, lustrous; dentate margins of chela fingers brown to reddish brown, with six rows of granules flanked by six inner accessory granules on fixed finger, and six rows of granules flanked by seven inner accessory granules on movable finger. Dorsal marginal keel moderately (poorly) developed, granular (smooth); dorsal secondary and digital keels moderately developed, smooth; external secondary keel

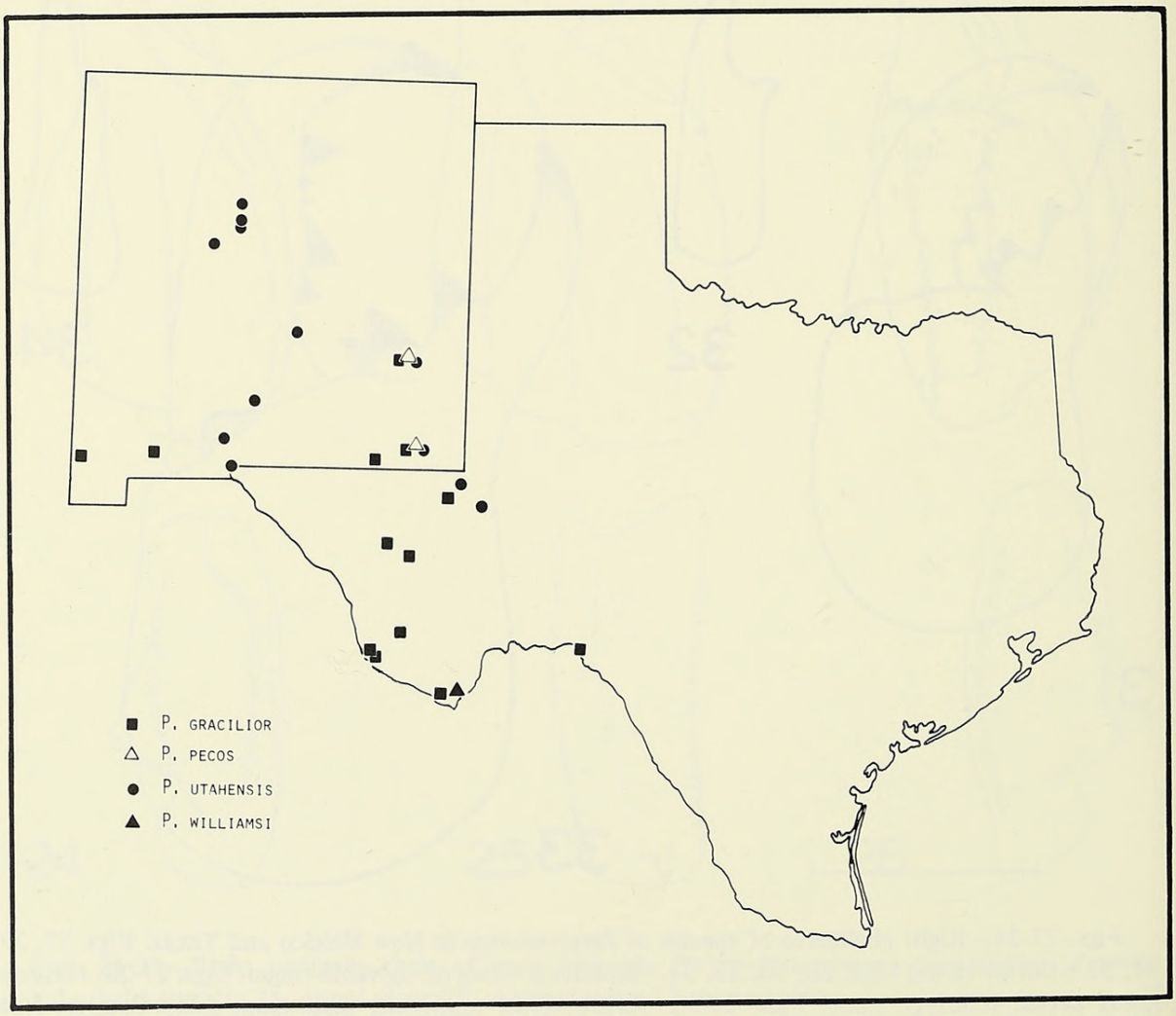


Fig. 35.–Map showing distribution of the genus *Paruroctonus* in Texas and New Mexico.

poorly developed, smooth; ventroexternal keel well developed, granular to crenulate (smooth to crenulate); ventromedian keel moderately developed, smooth; ventrointernal keel poorly developed, smooth; dorsointernal keel moderately developed, smooth to granular (smooth). Ratio of chela length to width about 2.90; of fixed finger length to chela length about 0.40; of movable finger length to fixed finger length 1.45.

Legs. Base color yellow; faint dusky coloration present on femora and patellae. Tarsomere I of legs I-III with dorsal row of 6-8 stout setae.

Comparisons.–Based on cheliceral dentition and carinal development, *P. pecos* is most similar to *P. williamsi* and *P. stahnkei*. From *P. williamsi* it differs in the following ways: (1) *P. pecos* has 1:1:1:2 pair of setae on the dorsolateral carinae of metasomal segments I-IV, *P. williamsi* has 1:3:3:3 pair; (2) *P. pecos* has the interocular area of the carapace delineated by a dusky crescent, whereas *P. williamsi* lacks this; and (3) in *P. pecos* metasomal carinal development is much weaker than in *P. williamsi*.

Paruroctonus pecos differs from *P. stahnkei* in the following ways: (1) *P. pecos* has 9-10 pair of setae along the ventrolateral carinae of metasomal segment V, whereas *P. stahnkei* has only 6-7 pair; (2) in *P. pecos* the granules on the ventral surface of metasomal segment V are few and sparsely distributed, but in *P. stahnkei* they are numerous and rather densely distributed; and (3) *P. pecos* has 1:1:1:2 pair of setae on the dorsolateral carinae of segments I-IV, and *P. stahnkei* typically has 0:1:1:2.

Variation.–Adults of *P. pecos* vary in the amount of dusky coloration on the carapace, pedipalps, legs, and cauda. Juveniles generally have more dusky markings and are paler in color than adults.

Pectinal tooth counts vary in males examined from 20-22. On males there are two combs with 20 teeth, four combs with 21, and two combs with 22. Pectinal tooth counts in females vary from 13-15. On females there are three combs with 13 teeth, nine combs with 14, and two combs with 15.

The setal formula for the ventral submedian carinae of metasomal segments I-IV is 3-4:4:4-5:5-6. For a more detailed analysis of the setal variation, consult Table 2. The ventrolateral carinae of metasomal segment V vary from 9-10 pair (one specimen has 8 pair).

Remarks.–Specimens of *Paruroctonus pecos* collected in Chaves Co., New Mexico were found along the roadside of Highway 380 in the Mescalero Sands area. The sand is consolidated, with a relatively dense cover of buffalo grass, yucca, and creosote scrub. A single specimen of *P. gracilior* was collected under the same conditions. However, on the dunes where sand is unstable and vegetation sparse, *P. utahensis* was the only species collected.

Specimens examined.–NEW MEXICO: *Chaves County*: 19.2 mi. W Caprock (on roadside), 21 March 1980 (W. D. Sissom), 1 imm. ♂ (WDS); 20.5 mi. W Caprock (on roadside), 22 March 1980 (W. D. Sissom), 4 ♀♀, 1 imm. ♂, 1 imm. ♀ (WDS), 2 ♀♀ (OFF): *Eddy County*: 15 mi. E Loving, July 1978 (C. Rudolph), holotype ♂ (AMNH), 1 ♂ paratopotype (OFF).

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