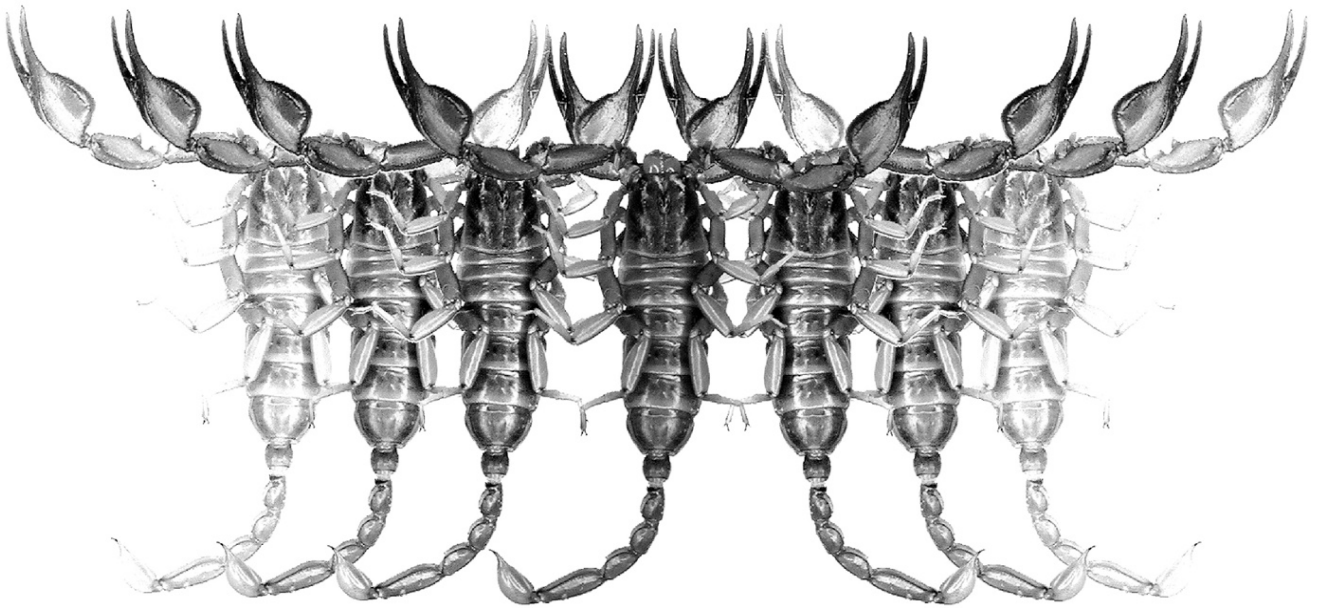


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**A new species of *Pseudouroctonus* from
the Pinaleno Mountains, southern Arizona
(Scorpiones: Vaejovidae)**

Richard F. Ayrey, František Kovařík & Brandon T. Myers

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A new species of *Pseudouroctonus* from the Pinaleno Mountains, southern Arizona (Scorpiones: Vaejovidae)

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Summary

A new scorpion species, *Pseudouroctonus moyeri* **sp. n.** (Scorpiones: Vaejovidae) is described. This large, dark, reddish brown species is found in the Pinaleno Mountains, Arizona. This is the largest species of *Pseudouroctonus* found in Arizona. *Ruberhieronymus* Rossi, 2018 is synonymized with *Pseudouroctonus* Stahnke, 1974

Introduction

There have been many changes to the vaejovid genus *Pseudouroctonus* in the last few years (Tate et al., 2013; Ayrey & Soleglad, 2015, 2017; Soleglad et al., 2014, 2016, 2017). Within the USA, new species were described from Nevada (*P. peccatum* Tate et al., 2013), Texas (*P. brysoni* Ayrey & Soleglad, 2017), and Arizona (*P. santarita* Ayrey & Soleglad, 2015 and *P. kremani* Ayrey & Soleglad, 2015). Including *P. apacheanus* (Gertsch & Soleglad, 1972) and the new species described in this paper, *P. moyeri* **sp. n.**, there are now four species of *Pseudouroctonus* in Arizona. There are now no species of *Pseudouroctonus* in the state of California, USA, since all of them were moved to three new genera: *Kovarikia* Soleglad et al., 2014, *Graemeloweus* Soleglad et al., 2016, and *Catalinia* Soleglad et al., 2017. Therefore, the total number of *Pseudouroctonus* species found in the USA is six: four in Arizona; two in Texas, *P. reddelli* (Gertsch & Soleglad, 1972) and *P. brysoni*; and one in Nevada.

The new Arizona species represents three of the populations in the “SE clade” of what Bryson et al. (2013) referred to as the “*Pseudouroctonus minimus* complex”. Ayrey & Soleglad (2015) pointed out that samples from other populations discussed in both papers needed further investigation to determine if they are also new species. This paper represents one of those investigations on the Pinaleno population of the genus *Pseudouroctonus*.

Methods, Materials & Abbreviations

Measurements are as described in Stahnke (1971), trichobothrial patterns are as in Vachon (1974), and pedipalp finger dentition follows Soleglad & Sissom (2001).

Abbreviations: RFA (personal collection of Richard F. Ayrey, Flagstaff, Arizona, USA); FKCP (František Kovařík, private collection, Prague, Czech Republic; will in future be merged with the collections of the National Museum of Natural History, Prague, Czech Republic); USNM (United States National Museum, Smithsonian Institution, Washington, DC, USA).

Systematics

Family Vaejovidae Thorell, 1876

Pseudouroctonus Stahnke, 1974

(Figures 1–35, Tables 1–2)

<http://zoobank.org/urn:lsid:zoobank.act:F9BF4E85-0736-474F-BD5E-72DB6E97E0F4>

SYNONYMS:

Ruberhieronymus Rossi, 2018, **syn. n.** Type species: *Uroctonus apacheanus* Gertsch & Soleglad, 1972.

<http://zoobank.org/urn:lsid:zoobank.act:09B26D51-A0F5-4EEA-BFAF-EA675732BB01>

Note: We synonymize here the generic name *Ruberhieronymus* Rossi, 2018, which was recently introduced for the “*Pseudouroctonus apacheanus*” group (i. e. *P. apacheanus*, *P. brysoni*, *P. kremani*, *P. santarita*). We see no justification and no detailed study of these species conducted by Rossi (2018) for separating this group from the rest of the genus *Pseudouroctonus*. In a bizarre statement, Rossi (2018: 28) says “since the present study is just a piece of the puzzle, it is impossible at the moment to establish how, and which, species indeed belong to the genus *Pseudouroctonus* Stahnke, 1974 *senso [sic] stricto*.”



Figures 1–2. *Pseudouroctonus moyeri* sp. n., paratypes, female (1) and male shortly after last ecdysis (2).

<i>Pseudouroctonus moyeri</i> sp. n.		♀ holotype (RA1171)	♀ paratype (RA1165)	♀ paratype (RA1167)	♀ paratype (RA1168)	♂ paratype (RA1172)	♂ paratype (RA1166)
Carapace	L	5.20	2.35	4.90	5.00	4.75	4.65
Mesosoma	L	11.40	11.10	11.10	8.20	10.90	8.20
Metasoma + telson	L	20.05	20.60	17.50	18.35	19.10	18.40
Segment I	L / W	2.00 / 2.45	2.20 / 2.55	1.90 / 2.35	1.90 / 2.30	1.95 / 2.45	1.80 / 2.40
Segment II	L / W	2.30 / 2.30	2.35 / 2.45	2.05 / 2.20	2.10 / 2.25	2.30 / 2.35	2.10 / 2.30
Segment III	L / W	2.50 / 2.20	2.55 / 2.30	2.15 / 2.10	2.30 / 2.20	2.40 / 2.30	2.30 / 2.25
Segment IV	L / W	3.15 / 2.10	3.20 / 2.25	2.70 / 2.00	2.85 / 2.00	2.90 / 2.25	3.00 / 2.15
Segment V	L / W	5.20 / 2.05	5.30 / 2.20	4.40 / 2.00	4.65 / 2.00	4.95 / 2.15	4.75 / 2.10
Telson	L / W	4.90 / 1.95	5.00 / 2.00	4.30 / 1.65	4.55 / 1.70	4.60 / 1.90	4.45 / 1.80
Vesicle	L / D	3.15 / 1.55	3.35 / 1.60	2.70 / 1.35	2.90 / 1.40	2.95 / 1.50	2.90 / 1.40
Aculeus	L	1.75	1.65	1.60	1.65	1.65	1.55
Pedipalp	L	17.85	17.70	15.50	15.90	15.75	15.75
Femur	L / W	4.50 / 1.65	4.50 / 1.70	4.00 / 1.40	4.10 / 1.40	4.00 / 1.50	4.00 / 1.50
Patella	L / W	4.65 / 1.90	4.60 / 2.00	4.00 / 1.70	4.25 / 1.70	4.10 / 1.75	4.15 / 1.80
Chela	L / W	8.70 / 2.70	8.60 / 2.75	7.50 / 2.20	7.55 / 2.35	7.65 / 2.60	7.60 / 2.60
Manus	L / D	4.50 / 3.40	4.50 / 3.50	4.00 / 2.80	3.95 / 2.80	4.10 / 3.25	4.20 / 3.25
Movable finger	L	4.90	4.80	4.15	4.30	4.20	4.10
Fixed finger	L	3.50	3.50	3.00	3.00	3.00	3.00
Total	L	36.65	37.05	33.50	31.55	34.75	31.25
Pectinal teeth count	PTC	8-8	9-9	9-9	9-9	11-11	11-11
Pectinal middle lamellae count	PMLC	6-6	5+-5+	5-5	6-6	7+-8	9-9
Sternum	L / W	1.20 / 1.45	1.40 / 1.50	1.30 / 1.40	1.20 / 1.50	1.20 / 1.30	1.20 / 1.35

Table 1. Comparative measurements (mm) of *Pseudouroctonus moyeri*, sp. n. types. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

***Pseudouroctonus moyeri* sp. n.**

(Figures 1–35, Tables 1–2)

<http://zoobank.org/urn:lsid:zoobank.act:4A54E946-1963-4D52-A0E4-C44D93243F13>

TYPE LOCALITY AND TYPE REPOSITORY. USA, Arizona, Graham County, Pinaleno Mountains, Mount Graham, 32.65077°N, 109.80945°W, 1,868 m a. s. l.; USNM.

TYPE MATERIAL. Holotype ♀, USA, Arizona, Pinaleno Mountains, Graham County, Mount Graham, 32.65077°N 109.80945°W, 1868 m a. s. l., 5 June 2015, leg. R. Moyer, specimen #1171 (USNM). Paratypes, 2♂2♀ (all from the same locality): 1♂, 5 June 2015, leg. R. Moyer, specimen #1172, (USNM); 1♀, 5 June 2015, leg. R. Moyer, specimen #1167 (RFA); 1♀, 5 June 2015, leg. R. Moyer, specimen #1168 (RFA); 1♂, 5 May 2010, leg. R. F. Ayrey, specimen #1174 (FKCP). The type specimens were found using a blacklight at night. The vegetation type is pine oak woodland (see Fig. 35). *Vaejovis electrum* Hughes, 2011 and *Centruroides sculpturatus* Ewing, 1928 were found syntopically with *P. moyeri* during five field trips to Mount Graham.

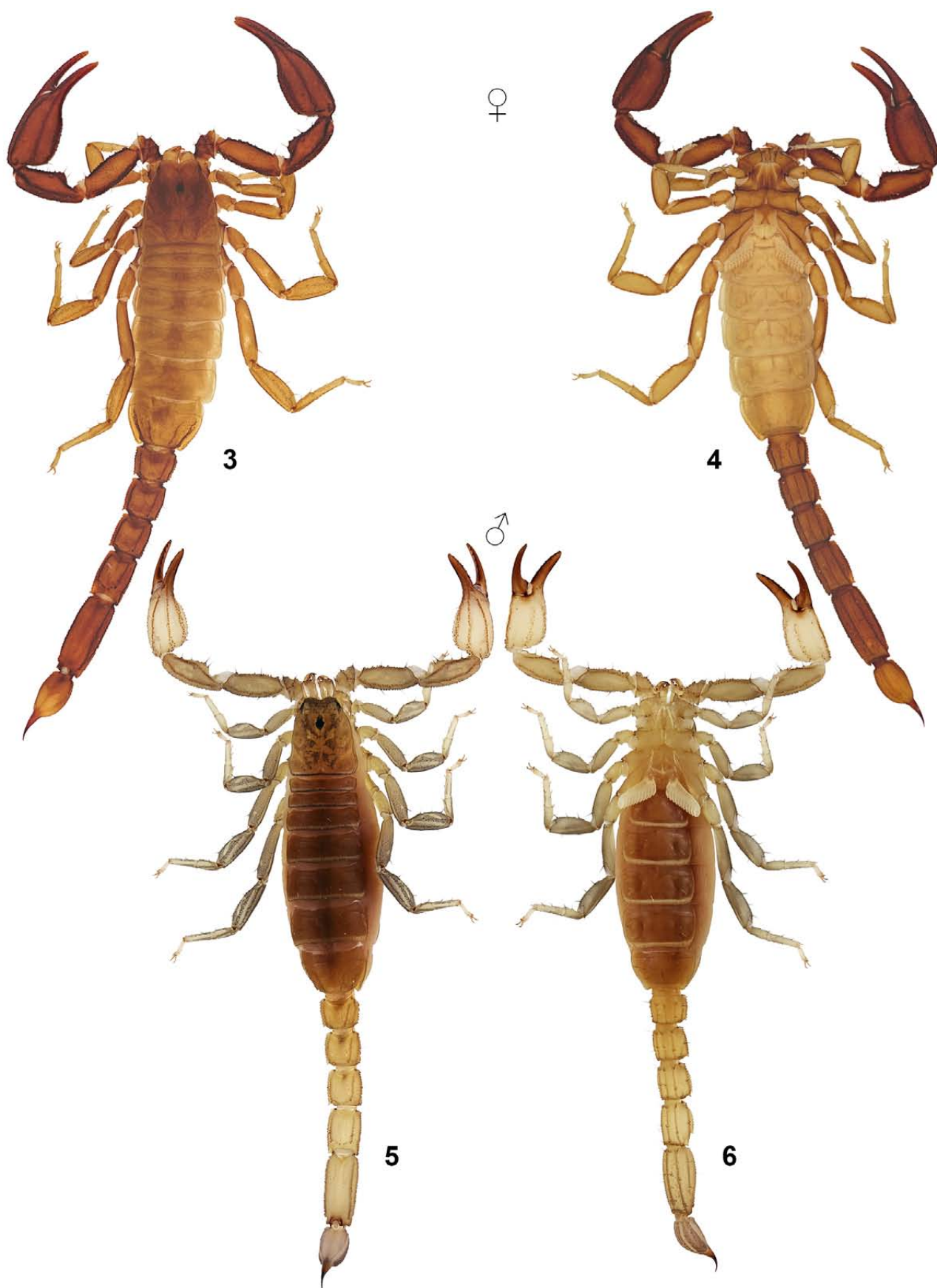
OTHER MATERIAL STUDIED. 1♂3♀ (same locality as paratypes): 1♂, 5 May 2010, leg. R. Moyer, specimen #1166, (RFA); 1♀, 5 June 2015, leg. R. Moyer, specimen #1165 (RFA); 1♀, 5 June 2015, leg. R. Moyer, specimen #1169 (RFA); 1♀, 5 June 2015, leg. R. Moyer, specimen #1170 (RFA).

ETYMOLOGY. This species is named in honor of Ryan Moyer who collected most of the type series.

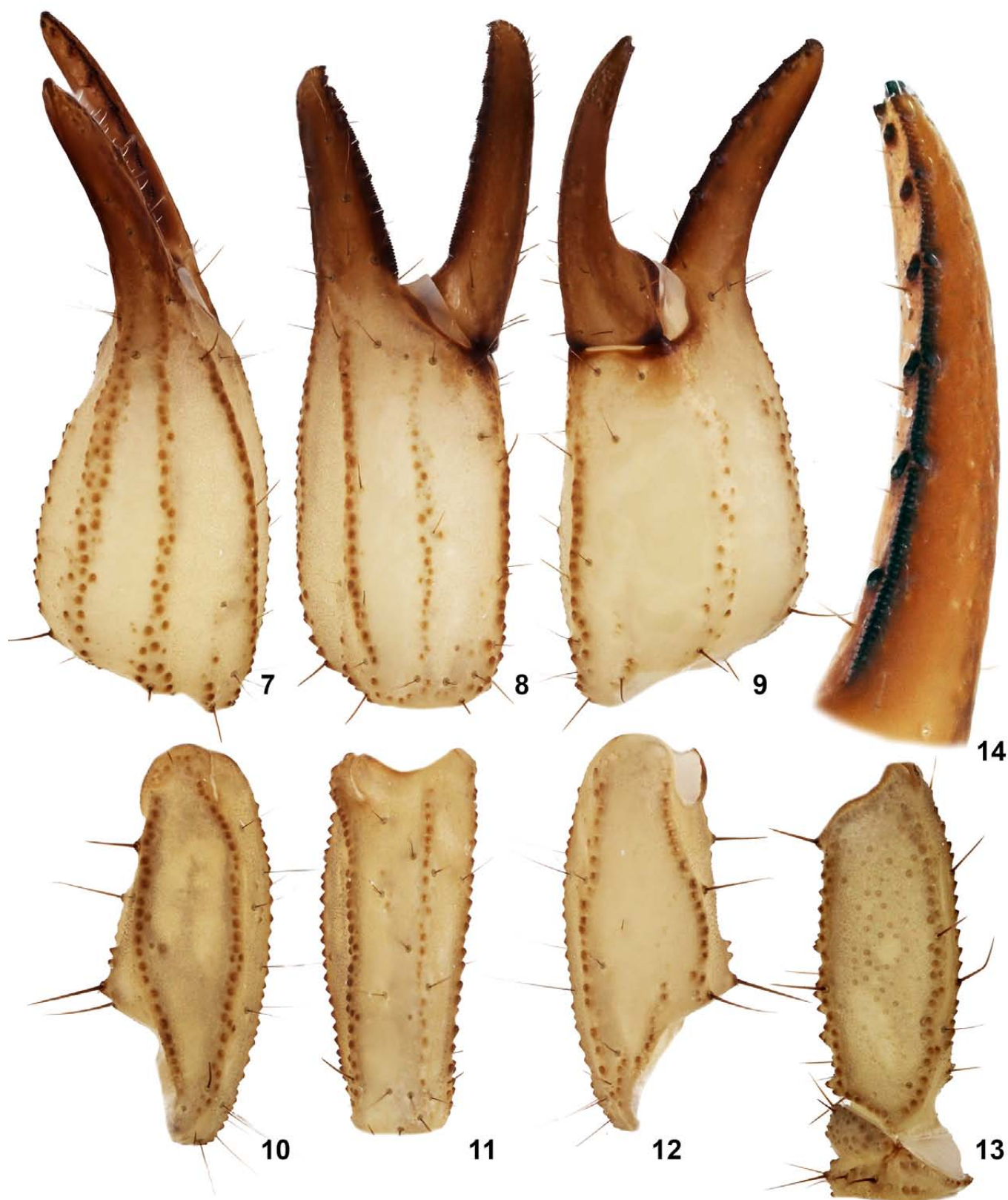
DIAGNOSIS. Large (32–37 mm) scorpions. Color is dark, reddish brown, lighter on legs (see Figs. 1–2), telson reddish. Pedipalp movable finger usually with 7 ID denticles and fixed finger usually with 6. Carapace of female is the same size or longer than the metasomal segment V. Mean pectinal tooth count: females 8.916 [n=12], males 11.00 [n=6].

Hemispermaphore (Figs. 22–25). Description based on left hemispermaphore. All measurements in mm. Hemispermaphore with wide base, deep dorsal trough. Lamina edges nearly parallel with no obvious basal constriction. Distinct distal crest on dorsal side of lamina, on posterior edge. Strongly bifurcated lamellar hook, originating from dorsal trough. Measurements as follows (mm): Total length = 4.47, lamina length = 2.74, lamellar hook length = 0.96, trough difference = 0.43, base width = 0.98, lamina width = 0.44. Morphometric ratios are as follows: lamellar hook length / lamina length = 0.35, trough difference / lamellar hook length = 0.45.

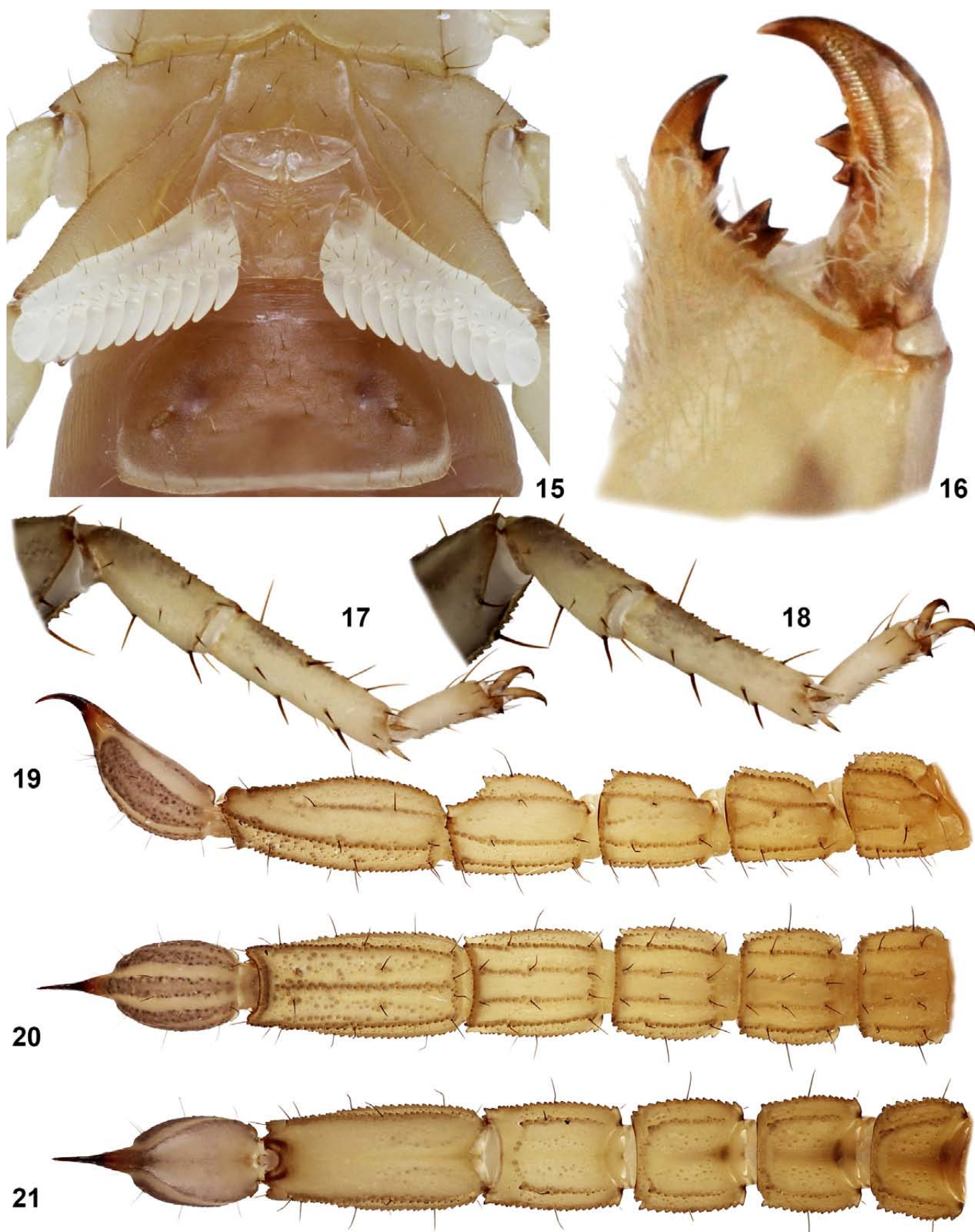
Mating Plug (Figs. 26–31). Sclerotized mating plug with wide base, wide stem. Smooth barb, with a slight roundedness, but not crescent-shaped. One tine of barb significantly longer than other. Stem projection present.



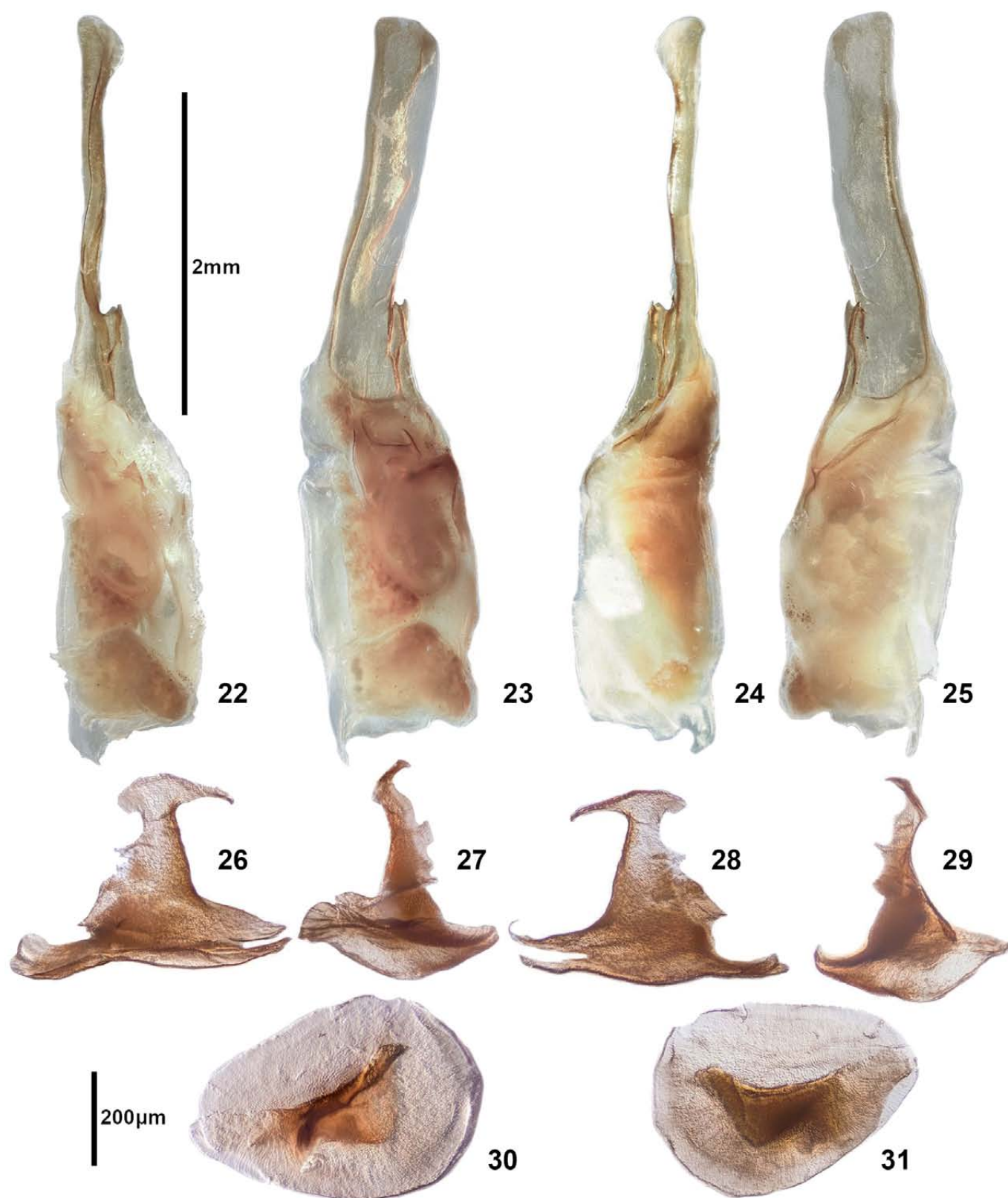
Figures 3–6: *Pseudouroctonus moyeri* sp. n., paratypes. **Figures 3–4.** Female in dorsal (3) and ventral (4) views. **Figures 5–6.** Male in dorsal (5) and ventral (6) views.



Figures 7–14. *Pseudouroctonus moyeri* sp. n., paratype male (FKCP), pedipalp. chela, dorsal (7), external (8), and ventral (9) views. Patella, dorsal (10), external (11) and ventral (12) views. Femur and trochanter dorsal (13). Movable finger (14).



Figures 15–21. *Pseudouroctonus moyeri* **sp. n.**, paratype male (FKCP), sternoplectinal area (15), left chelicerae, ventral view (16), right legs III–IV, retrolateral aspect (17–18), metasoma and telson lateral (19), ventral (20) and dorsal (21) views.



Figures 22–31: *Pseudouroctonus moyeri* sp. n., paratype male (USNM). **Figures 22–25.** Hemispermaphore internal (22), ventral (23), external (24), and dorsal (25) views. **Figures 26–31.** Mating plug dorsal (26), distal (27), ventral (28), proximal (29), internal (30), and external (31) views.

DESCRIPTION. Based on holotype female, unless otherwise noted.

Color. Color is dark, reddish brown, lighter on the legs, telson reddish.

Carapace. Carapace of female is longer than the metasomal segment V. Anterior edge with a conspicuous median indentation, providing a ratio of 0.066 when its depth is compared to the carapace's length; edge with six setae visible; entire surface moderately covered with medium sized granules. Three lateral eyes are present. Median eyes and tubercle of medium size, positioned anterior of middle with the following length and width ratios: 0.344 (anterior edge to medium tubercle middle / carapace length) and 0.129 (width of median tubercle including eyes / width of carapace at that point).

Metasoma. Length/width ratio of segment I 0.76; segment II 0.95; segment III 1.02; segment IV 1.42; segment V 2.30. Segments I–IV: dorsolateral carinae moderate, granular with distal denticle of I–IV enlarged and spinoid. Lateral supramedian carinae I–IV strong and granular with enlarged spinoid distal denticle. Lateral inframedian carinae moderately granular on segment I, posterior half of segment II, one-third of segment III, and obsolete on distal one-fourth of segment IV. Ventrolateral carinae on segments I–II strong, granular; on III–IV moderate, granular. Ventral submedian carinae weak on segment I and II, weak to moderate on III, moderate, granular on IV. Dorsal and lateral intercarinal spaces finely granular. Segment I–IV ventral submedian setae 3/3. Segment V dorsolateral carinae strong. Lateromedian carinae moderate and granular on basal 3/5, obsolete on distal 2/5. Ventrolateral and ventromedian carinae strong. Intercarinal spaces finely granular. Segment V ventrolateral setae 3/3.

Telson. Smooth with 4 pairs of large setae on the ventral surface, 3 large setae along both lateral edges of the vesicle and numerous smaller setae. Small, spinoid subaculear tubercle present.

Mesosoma. Tergites finely granular, with vestigial median carina on tergites I–VI. Tergite VII with weak median carina on anterior one-third and strong dorsal lateral and lateral supramedian granular carinae. Sternites III–VI very finely granular and without carinae. Sternite VII with vestigial ventral lateral carinae on middle third. Presternites smooth. Spiracles ovoid with median side rotated 35 degrees from posterior sternite margin. Sternites with variable number of microsetae. Pectinal tooth count 08/08 for holotype female. All pectinal teeth have exerodistal angling with large sensorial area. Middle lamellae 6/6. Fulcra are present. Each fulcra with 1–3 central setae. Sternum is Type 2. Genital Operculum is sclerites separated on posterior one-third.

Chelicerae. Dorsal edge of movable cheliceral finger with two subdistal (*sd*) denticles. Ventral edge is smooth, with well developed serrula on distal half.

Pedipalps. Trichobothrial pattern type C (Vachon, 1974, Figs. 7–13). Trichobothria *ib* and *it* are at the base of fixed finger. Pedipalp ratios: chela length/width 3.22; femur length/width 2.73; patella length/width 2.45; fixed finger length/carapace

length 0.67. Chela with carinae moderate. Fixed finger median denticles (MD) aligned and divided into 6 subrows by 5 outer denticles (OD) and 6 inner denticles (ID). Movable finger with 6 subrows of MD, 5 OD and usually 7 ID (Soleglad & Sissom, 2001). Femur with carinae moderate. Patella with carinae strong, internal surface with very large granules on the *DPSc* carina.

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

VARIABILITY. Pectinal tooth count 8/8 [*n*=1], 9/9 [*n*=4], 9/10 [*n*=1] with a mean of 8.916 [*n*=12], standard deviation 0.493 for females and 11/11 [*n*=3] with a mean of 11.00 [*n*=6], standard deviation 0.00 for males.

REPRODUCTION. Four females were kept alive in order to observe them giving birth and to count the number of first instar juveniles (see Fig. 33). All four females gave birth between the 28th of August and the 2nd of September, 2015. The juvenile counts were 34, 32, 35, and 35; mean = 34.0 (*n*=4), SD 1.2247. The 1st instar orientation on the mother's back was “non-random”, as reported by Ayrey (2009, 2013a, 2013b, 2020). They were facing anteriorly with the prosoma down and the metasoma raised over the prosoma of the juvenile immediately posterior to them, the same orientation as in *Pseudouroctonus santarita* and *P. kremani* (Ayrey & Soleglad, 2015). Postpartum behavior is as described in Ayrey (2013a).

DISTRIBUTION. Known only from the type locality, Mount Graham, Pinaleno Mountains, Graham County, Arizona, USA.

Affinities

Map in Fig. 34 shows the type localities of the four currently known species of *Pseudouroctonus* from Arizona, western New Mexico, and northern Sonora. Comparisons of *P. moyeri* **sp. n.** are made to these species.

***Pseudouroctonus apacheanus*.** The female total length of *P. moyeri* is larger than in *P. apacheanus*, therefore it is the largest species of *Pseudouroctonus* in Arizona. There is no overlap in three important morphometric ratios (see Table 2) with *P. moyeri* **sp. n.** Recent DNA analysis (Bryson et al., 2013) estimates that lineages represented by *P. moyeri* **sp. n.** and *P. apacheanus* diverged approximately 8.11 million years ago (Ma). Our new species *P. moyeri* **sp. n.** is listed as the Pinaleno population in Bryson et al. (2013).

***Pseudouroctonus kremani*.** There is no overlap in eight important morphometric ratios (see Table 2) with *P. moyeri*. Recent DNA analysis (Bryson et al., 2013) estimates that lineages represented by *P. moyeri* **sp. n.** and *P. kremani* diverged 4.74 Ma. *P. kremani* is also widely allopatric with *P. moyeri* **sp. n.** *P. kremani* represents the Catalina population in Bryson et al. (2013).

***Pseudouroctonus santarita*.** The female total length of *P. moyeri* **sp. n.** is larger than in *P. santarita*. Seven important



Figure 32–33. *Pseudouroctonus moyeri* sp. n., paratype juvenile female 4th instar (32) and female with newborns (33).

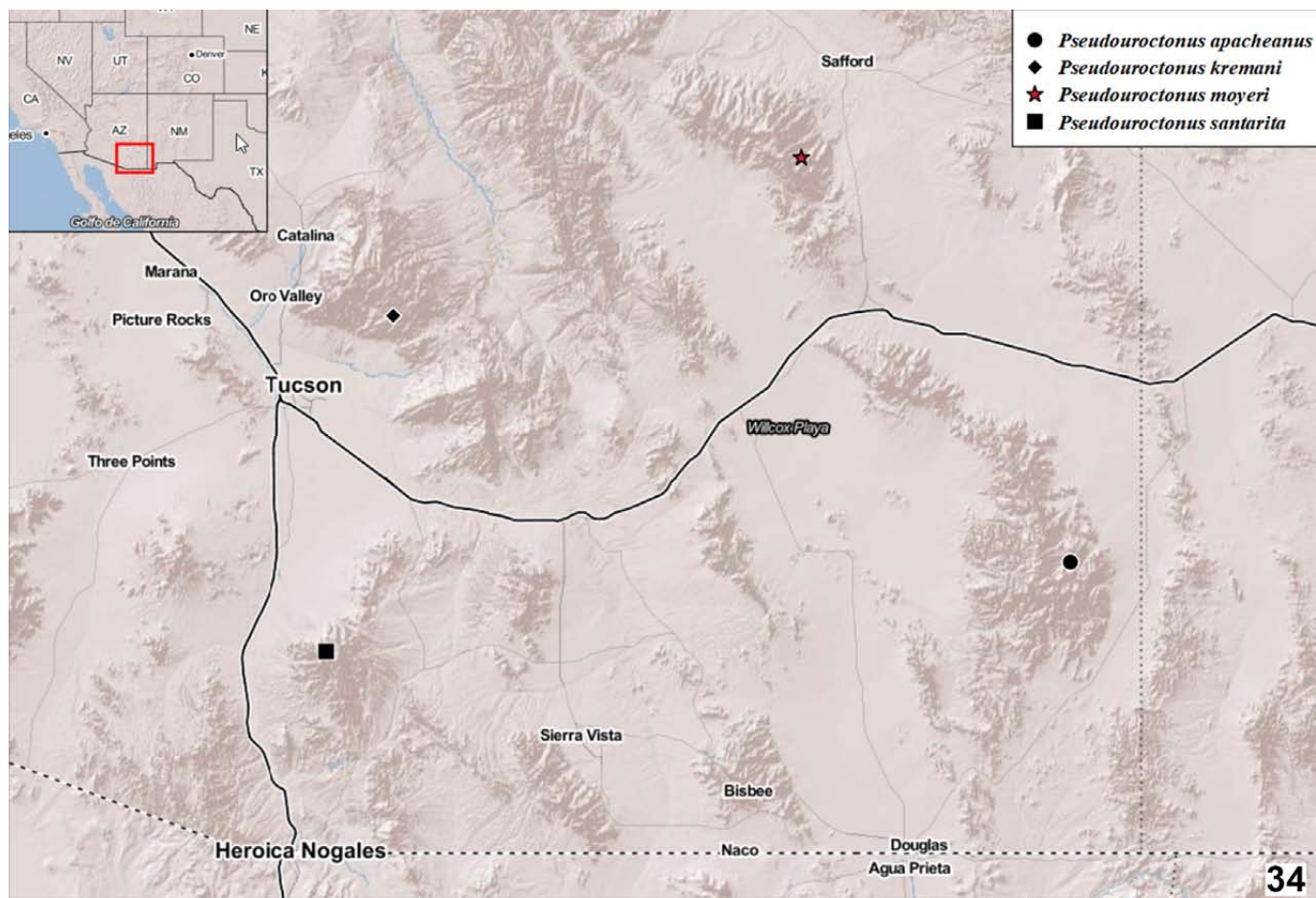


Figure 34–35: **Figure 34.** Map showing the type localities for the four species of *Pseudouroctonus* known from southern Arizona. **Figure 35.** *Pseudouroctonus moyeri* sp. n., type locality.

	<i>P. moyeri</i> sp. n. ♀ (4)	<i>P. apacheanus</i> ♀ (3)	<i>P. santarita</i> ♀ (3)	<i>P. kremani</i> ♀ (3)
Total length	31.55–37.05	24.70–29.34	28.10–31.29	30.66–32.32
Carapace length	4.90–5.35	3.90–4.51	4.06–4.55	4.10–4.72
Carapace L/Metasoma V L	1.00–1.11	0.91–1.05	1.04–1.06	1.01–1.06
Metasoma I, L/W	0.81–0.86	0.66–0.70	0.57–0.58	0.70–0.77
Metasoma II, L/W	0.93–1.00	0.83–0.94	0.78–0.81	0.85–0.90
Metasoma III, L/W	1.02–1.42	0.94–0.96	0.90–0.93	1.06–1.10
Metasoma IV, L/W	1.35–1.50	1.29–1.41	1.21–1.27	1.39–1.43
Metasoma V, L/W	2.20–2.54	2.18–2.69	2.06–2.16	2.34–2.36
Telson L/W	1.62–1.71	1.49–1.87	1.38–1.50	1.28–1.30
Femur L/W	2.65–2.93	2.72–3.09	2.38–2.97	3.29–3.33
Patella L/W	2.30–2.50	2.00–2.44	1.58–1.96	2.66–2.75
Chela L/W	3.13–3.41	2.59–2.71	2.29–2.78	2.79–2.86
Fixed finger L/Carapace L	0.60–0.67	0.62–0.72	0.55–0.64	0.80–0.85
Fixed finger L/Chela L	0.40–0.41	0.41–0.42	0.38–0.40	0.43–0.51
Pectinal teeth number	8–9	9–11	8–10	9–10
middle	8.916(12)	9.79(14)	9.06(31)	9.469(32)

Table 2: Morphometrics (mm) of *Pseudouroctonus moyeri*, sp. n. compared to the other Arizona *Pseudouroctonus*. Abbreviations: length (L), width (W).

morphometric ratios do not overlap with *P. moyeri* sp. n. (see Table 2). Recent DNA analysis (Bryson et al., 2013) estimates that lineages represented by *P. moyeri* sp. n. and *P. santarita* diverged 21.02 Ma. *P. santarita* is also widely allopatric with *P. moyeri* sp. n. *P. santarita* was listed as the Santa Rita population in Bryson et al. (2013).

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