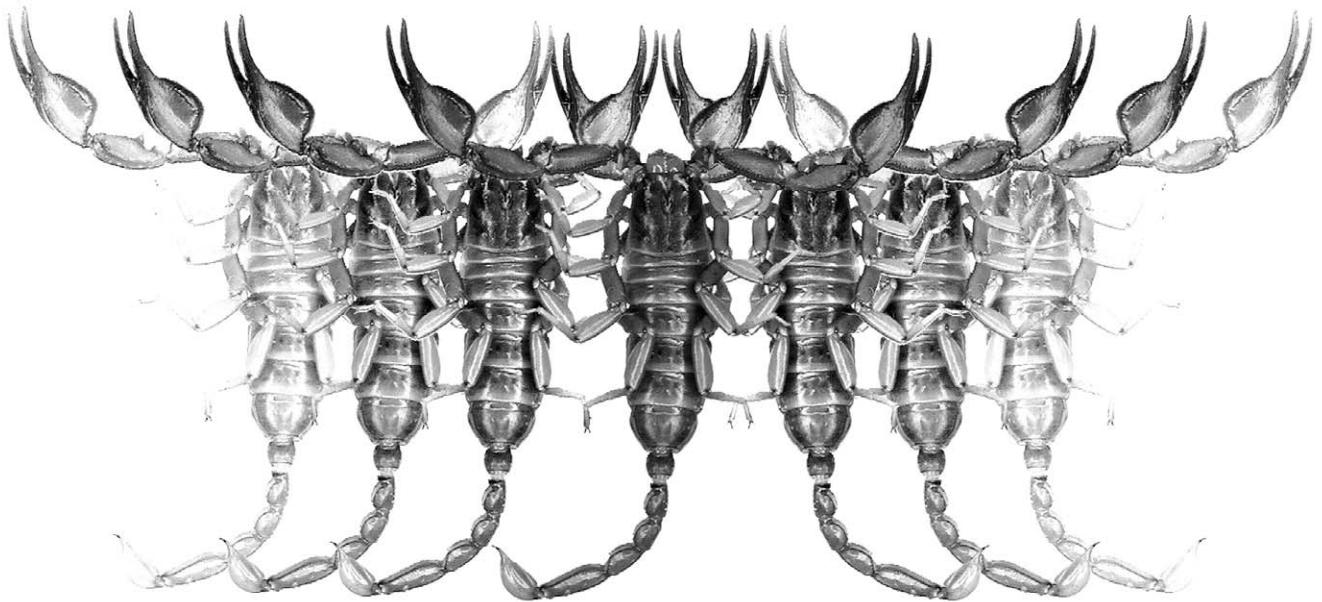


Euscorpium

Occasional Publications in Scorpiology



**A New Species of the “*apacheanus*” Group of Genus
Pseudouroctonus from Western Texas
(Scorpiones: Vaejoidea)**

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A new species of the “*apacheanus*” group of genus *Pseudouroctonus* from western Texas (Scorpiones: Vaejovidae)

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Summary

A new species of the “*apacheanus*” group of genus *Pseudouroctonus* is described from western Texas, USA, *Pseudouroctonus brysoni*, **sp. nov.** This new species is closely related to *P. apacheanus* (Gertsch et Soleglad, 1972) and two other species recently described from southern Arizona. A combination of morphological differences in the hemispermatophore, the mating plug, and several morphometric-based characters are identified as diagnostic.

Introduction

Ayrey & Soleglad (2015) recently described two new species of the “*apacheanus*” group of genus *Pseudouroctonus* from southern Arizona (i.e., *P. kremani* and *P. santarita*). These populations were studied primarily due to the DNA-based study of Bryson et al. (2013) which analyzed several taxa from a “group” they referred to as the “*minimus*” complex. In their study, they identified a western Texas population of the species *P. apacheanus*, which, according to DNA markers, is estimated to have a mean separation of 14.51 Mya from the clade containing the nominotypic species *P. apacheanus* (refer to their figure 3).

Our research team has been studying the genus *Pseudouroctonus* since 2013, when Tate et al. (2013) named the unusual species *P. peccatum* from Nevada (or, even back further to 1972, if you consider Gertsch & Soleglad (1972)’s contribution!). From this team-effort two new genera, *Kovarikia* Soleglad, Fet et Graham, 2014, and *Graemeloweus* Soleglad, Fet, Graham et Ayrey, 2016, were described, further elucidating the relationships within this interesting “genus” *Pseudouroctonus*. In the latter contribution the authors stated “... it appears that the “*apacheanus*” group, which currently includes species *P. apacheanus*, *P. santarita*, *P. kremani*, *P. rufulus*, *P. savvasi*, and *P. chicano* should probably be considered a unique genus ...”. This current paper is a continuation of this proposition where it describes another important species from a population in western Texas.

Materials and Methods

Terminology and conventions

Measurements are as described in Stahnke (1971) and Sissom (1990), trichobothrial patterns are as in Vachon (1974), pedipalp finger dentition and chelal carinae follows Soleglad & Sissom (2001), sternum terminology as described in Soleglad & Fet (2003a), cheliceral dentition terminology as described by Soleglad & Fet (2003b), and the hemispermatophore follows Soleglad & Fet (2008) and Ayrey & Soleglad (2015). Note, with respect to the mating plug, we have changed the term “stock” to a more appropriate term, “stem”. Morphometric techniques used in this paper are discussed in detail in Ayrey & Soleglad (2015).

Abbreviations

MES, personal collection of Michael E. Soleglad, Winchester, California, USA; RFA, personal collection of Richard F. Ayrey, Flagstaff, Arizona, USA; USNM, United States National Museum, Smithsonian Institution, Washington, DC, USA.

Map generation software package

Map was generated by Earth Explorer 6.1, with positional and altitude data compiled through Google Maps.

Material Examined

In addition to the type material listed for the new species described in this paper, the following material was also examined.

***Pseudouroctonus apacheanus* (Gertsch et Soleglad, 1972) [6 specimens]**

Chiricahua Mountains, Rucker Canyon, Arizona, USA, 5 September 2008, 1 ♂, leg. R. F. Ayrey, (RA836, RFA); Chiricahua Mountains, Cave Creek, Arizona, USA, 8 February 2008, 1 ♀, leg. R. F. Ayrey, (RA1106, RFA); 16 August 2115, 1 ♂, leg. R. F. Ayrey, (RA2133, RFA); 24 August 2014, 1 ♀, leg. R. F. Ayrey, (RA1107, RFA); 20 August 2012, 1 ♂, leg. R. F. Ayrey, (RA1097, RFA); Chiricahua Mountains, Sunset Campground, Arizona, USA, 2 August 2008, 1 ♀, leg. R. F. Ayrey, (RA552, RFA).

***Pseudouroctonus kremeni* Ayrey et Soleglad, 2015 [5 specimens]**

Holotype ♀, Seven Cataracts Overlook, Catalina Highway, Santa Catalina Mountains, Pima County, Arizona, USA (32.35202, -110.72495; 1601 m asl), 25 August 2014, leg. R.F. Ayrey (RA1020, USNM); paratypes 2 ♀, same locality and date, (RA1019, RA1018 RFA); Molino Basin, Santa Catalina Mountains, Pima County, Arizona, USA, 19 August 2012, 1 ♂, leg. R.F. Ayrey (RA707, USNM), same locality, 19 October 2014, 1 ♀, leg. R.F. Ayrey (#1074, RFA).

***Pseudouroctonus santarita* Ayrey et Soleglad, 2015 [6 specimens]**

Holotype ♀, Madera Canyon, Santa Rita Mountains, Santa Cruz County, Arizona, USA (31.71325, -110.87507; 1641 m asl.), 5 September 2008, leg. R. F. Ayrey, (RA353, USNM); paratype ♂, same locality, 13 July 2014, leg. R.F. Ayrey, (RA953, USNM); Paratypes 2 miles west of Pena Blanca Lake, Atascosa Mountains, Santa Cruz County, Arizona, USA, 1 March 2009, 1 ♀, leg. T. Miscione, (#551, RFA); east side of the Santa Rita Mountains, southwest of Patagonia, Santa Cruz County, Arizona, USA, 12 April 2014, 1 ♀, leg. T. Miscione, (RA1160, RFA); Ruby Road, Pajarito Mountains, Santa Cruz County, Arizona, USA, 1 March 2009, 1 ♀, leg. T. Miscione, (#213, RFA); off Harshaw Road, Patagonia Mountains, Santa Cruz County, Arizona, USA, 25 July 2008, 1 ♀, leg. R. Troup, (#1100, RFA).

Systematics

Order **SCORPIONES** C. L. Koch, 1850
Suborder Neoscorpiones Thorell et Lindström, 1885
Infraorder Orthosterni Pocock, 1911

Parvorder Iurida Soleglad et Fet, 2003
Superfamily Chactoidea Pocock, 1893
Family Vaejovidae Thorell, 1876
Subfamily Vaejovinae Thorell, 1876
Genus *Pseudouroctonus* Stahnke, 1974

***Pseudouroctonus brysoni* Ayrey et Soleglad, sp. nov.**
(Figs. 1–13; Table 1)

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REFERENCES:

Uroctonus apacheanus: Gertsch & Soleglad, 1972: 576, 577 (in part).
Pseudouroctonus apacheanus: Bryson et al., 2013: 6, figs. 1, 2.

Type material. Holotype ♂, Musquiz Canyon, Hwy 118 N Alpine, Jeff Davis County, Texas, USA (30.53603, -103.84914, 1470 m), 6 August 2016. leg. R. Bryson, (specimen RA2415 deposited in USNM). Paratypes: ♀, ♂, same locality, 6 August 2016, leg. R. Bryson, (specimens RA2412 deposited in USNM, RA2414 MES); 2 ♂, Hwy 118, south of turn to McDonald Observatory, Jeff Davis County, Texas, 5 August 2016, leg. R. Bryson, (specimen #RA2422 deposited in USNM, RA2223 MES); 2 ♂, Madera Canyon, Hwy 118, Jeff Davis County, Texas, USA, 5 August 2016, leg. R. Bryson, (specimen RA2416 deposited in USNM, RA2419 MES).

Diagnosis. Small species with heavy chelae, 20–27 mm. Pectinal tooth counts 10–12 males, 10 females; metasoma segment V stocky, length to width ratio 1.97–2.06 in males; telson vesicle depth and width to fixed finger length ratio is 0.57–0.65 and 0.74–0.80 in males; fixed finger *MD* counts 48–55 for males and 52–53 for females; hemispermatophore lamina terminus with distal crest; mating plug brace-A and brace-B without projections.

Distribution. Jeff Davis County, Texas, USA. See map in Fig. 14.

Etymology. This species is named in honor of Robert W. Bryson, Jr. for his contributions to the biogeography of scorpions. Dr. Bryson also kindly provided the specimens used in this study as well as photographs of their locality.

MALE. The following description is based on holotype male from the Musquiz Canyon, Jeff Davis County, Texas, USA. Measurements of the holotype male and six paratypes are presented in Table 1. See Figure 1 for photographs of live paratype male and female specimens.



Figure 1: *Pseudouroctonus brysoni* sp. nov. paratype female and male from Musquiz Canyon, Jeff Davis County, Texas in life.

COLORATION. Carapace and mesosoma brown. Metasoma brown with darker carinae; telson vesicle orange-brown. Pedipalps brown with darker reddish carinae. Sternopectinal area, sternites, and legs light brown.

CARAPACE (Fig. 2). Anterior edge with a conspicuous narrow median indentation, providing a ratio of 0.040 when its depth is compared to the carapace's length; edge with six primary setae visible; entire median surface densely covered with medium sized granules. Three lateral eyes are present, the posterior eye considerably smaller. Median eyes and tubercle of medium size, positioned anterior of middle with the following length and width ratios: 0.337 (anterior edge to medium tubercle middle / carapace length) and 0.182 (width of median tubercle including eyes / width of carapace at that point).

MESOSOMA (Figs. 4, 7, 10). Tergites I–VII densely covered with small granules, heaviest posteriorly; tergite VII lateral and median carinae strong and crenulate. Sternites III–V smooth, VI–VII with small dense granules on posterior lateral aspects; sternite VII with weak irregularly granulated lateral carinae and obsolete median carinae (Fig. 7). Stigmata (Fig. 4) are small to medium in size and elliptical in shape.

METASOMA (Fig. 9). Segments I–III wider than long. Segments I–IV: dorsal and dorsolateral carinae serrated; dorsal and dorsolateral (I–III) carinae terminate with an enlarged spine; lateral carinae serrated on I, serrated on posterior two-thirds on II and posterior one-fifth on III, obsolete on segment IV; ventrolateral and ventromedian carinae serrated. Dorsolateral carinae of segment IV terminate slightly above the articulation condyle. Segment V: dorsolateral carinae rounded and granulate to serrate; lateral carinae serrated for two-thirds of posterior aspect; ventrolateral and single ventromedian carinae serrated; ventromedian carina not bifurcated, terminating in straight line. Anal arch with 15 small granules. Intercarinal areas of segment V ventral surface scattered with minute granules.

TELSON (Fig. 9). Vesicle fairly robust with some low-profile granules located on the ventral surface; slight setation on ventral surface. Aculeus with medium curve, well delineated from the vesicle when viewed ventrally. The subaculear setal pair is located on the vesicle/aculeus juncture. A vesicular linear patch on the dorsal surface is absent. Vesicular tabs with a single small curved spine.

PECTINES (Fig. 10, paratype male). Well-developed segments exhibiting length / width ratio 2.429 (length taken at anterior lamellae / width at widest point including teeth). Sclerite construction complex, three an-

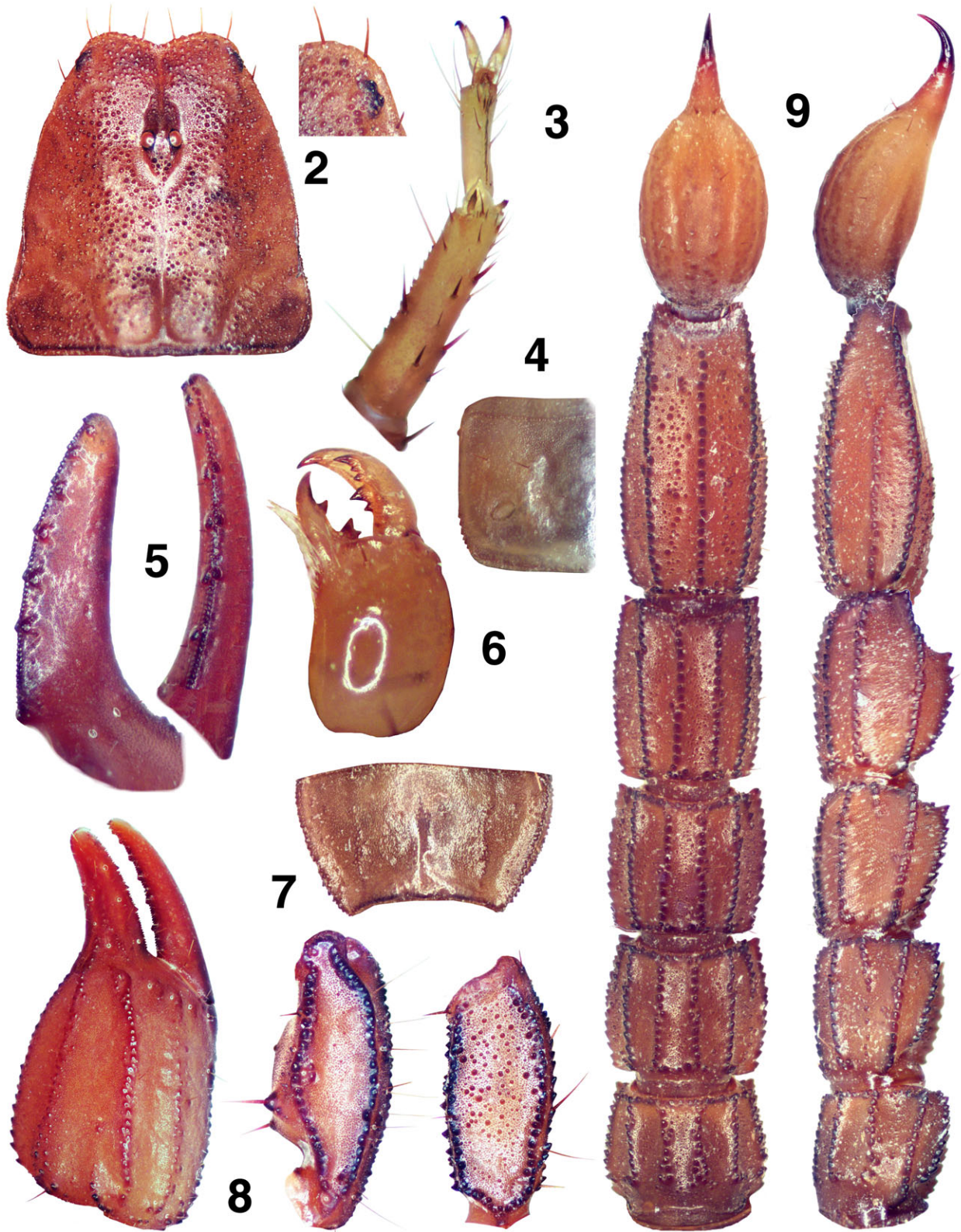
terior lamellae and seven middle lamella; fulcra of medium development. Teeth number 11/11. Sensory areas developed along most of tooth inner length on all teeth, including basal tooth. Scattered setae found on anterior and middle lamellae, fulcra, and distal pectinal tooth. Basal piece large, with well developed wide indentation along anterior edge, length / width ratio 0.550.

GENITAL OPERCULUM (Fig. 10, paratype male). Sclerites triangular, wider than long, separated, genital papillae protruding posteriorly.

STERNUM (Fig. 10, paratype male). Type 2, posterior emargination present, well-defined convex lateral lobes, apex shallow; sclerite wider than long, in ratio 0.636.

CHELICERAE (Fig. 6). Movable finger dorsal edge with two subdistal (*sd*) denticles; ventral edge smooth with well developed serrula on distal half (with 27 tines). Ventral distal denticle (*vd*) longer than dorsal (*dd*). Fixed finger with four denticles, median (*m*) and basal (*b*) denticles conjoined on common trunk; no ventral accessory denticles present.

PEDIPALPS (Figs. 5, 8, 11). Well-developed chelae, with short fingers, carinae well developed, no scalloping on the fingers. Planes formed by carinae *D1|D3|D4* and *V1|V2|V3* are essentially parallel. **Femur:** Dorsointernal and ventrointernal carinae heavily serrated, dorsoexternal crenulated, and ventroexternal with scattered rounded granules. Dorsal and ventral surfaces scattered with granules, internal surface scattered with large granules, and external surface smooth. **Patella:** Dorsointernal, ventrointernal, dorsoexternal and ventroexternal carinae heavily serrated, and exteromedian carina singular, strong and crenulated. Dorsal and ventral surfaces essentially smooth, rough but with no granulation; external surface with serrated exteromedian carina and 2–3 small granules in proximity of trichobothrium *est*; internal surface smooth with medium sized DPS and small VPS. **Chelal carinae:** Complies to the “10-carinae configuration”. Digital (*D1*) carina strong and serrated; subdigital (*D2*) essentially obsolete, composed of two small granules; dorsosecondary (*D3*) flat lined with delicate granules; dorsomarginal (*D4*) medium to strong with scattered granulation; dorsointernal (*D5*) medium with large granules; ventroexternal (*V1*) strong and serrated, terminating at external condyle of movable finger; ventromedian (*V2*) essentially obsolete; ventrointernal (*V3*) strong with scattered granulation; external (*E*) medium, lined with small granules. **Chelal finger dentition (Fig. 5):** Median denticle (*MD*) row groups aligned in a straight line, 6 on the fixed and movable fingers; 6/6 *ID*s on fixed finger and 7/7 *ID*s on movable finger; 5/5 *OD*s on fixed finger and 6/6 *OD*s on movable finger. No



Figures 2–9: *Pseudouroctonus brysoni*, *sp. nov.*, holotype male. 2. Carapace and closeup of right lateral eyes. 3. Right leg III basitarsus and tarsus, ventral view. 4. Right stigma III. 5. Chela fixed and movable finger dentition. 6. Right chelicera, dorsal view, showing smooth ventral edge. 7. Sternite VII. 8. Right chela, patella, and femur. 9. Metasoma and telson, ventral and lateral views.



Figure 10: *Pseudouroctonus brysoni*, sp. nov., male paratype, Madera Canyon, Jeff Davis Co., Texas, USA, sternopectinal area.

accessory denticles present. The number of MDs on the fixed finger for each row: right finger: $md1 = 5$, $md2 = 5$, $md3 = 8$, $md4 = 7$, $md5 = 8$, $md6 = 17$: total = 50; left finger: $md1 = 4$, $md2 = 8$, $md3 = 7$, $md4 = 6$, $md5 = 8$, $md6 = 15$: total = 48. **Trichobothrial patterns (Fig. 11):** Type C, orthobothriotaxic. Trichobothria *ib-it* located basally, *ib* on the palm and *it* on the fixed finger base; chelal V_4 is located on the VI carina; *Db* is located external to the $D1$ carina; *Dt* is positioned well on the proximal half of the palm; patellar v_3 is located slightly posterior to et_3 .

LEGS (Fig. 3). Both pedal spurs present on all legs, lacking spinelets; tibial spurs absent. Ventral surface of the tarsus with a median row of short spinules termi-

nating distally with two pairs of spinules. Unguicular spine well-developed and pointed.

HEMISPERMATOPHORE (FIG. 12, three paratype males). Lamina edges subparallel, terminus truncated with a subtle distal crest on the dorsal side (also visible from the ventral side due to the structure's translucency). Lamellar hook elongated, distinctly bifurcated, and originating from the dorsal trough. A secondary lamellar hook and basal constriction are absent. Right hemispermatophore length is 4.20 mm, lamina length is 2.50 mm, lamellar hook length is 1.05 mm, and trough difference is 0.50 mm. Lamellar hook length to lamina length ratio is 0.420 and trough difference to lamellar hook length ratio is 0.476. Mating plug with a smooth barb, its distal edges essentially straight, thus not "crescent-shaped". Projections from brace-A and brace-

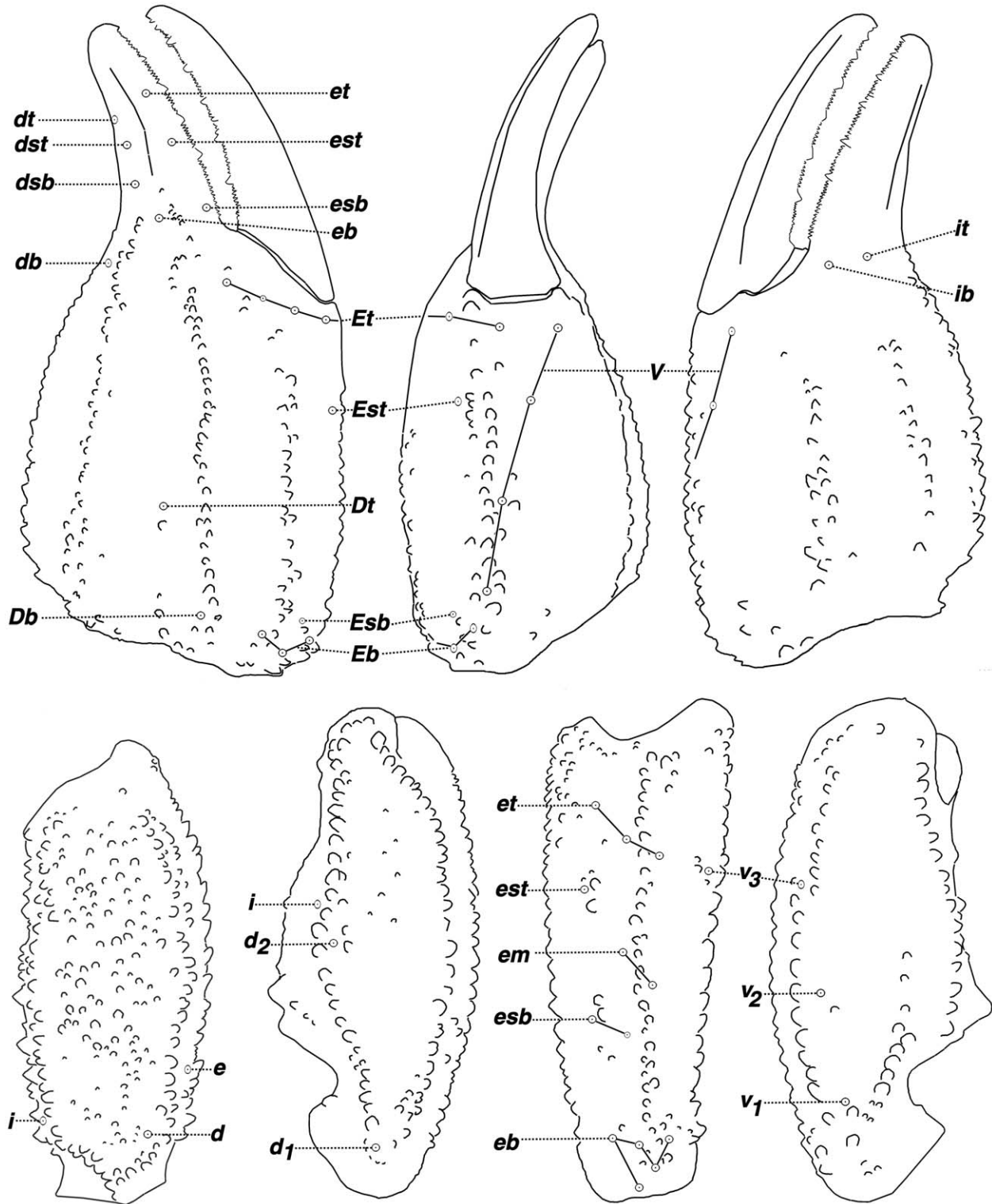


Figure 11: *Pseudouroctonus brysoni*, sp. nov., holotype male, Musquiz Canyon, Jeff Davis Co., Texas, USA. Trichobothrial pattern.

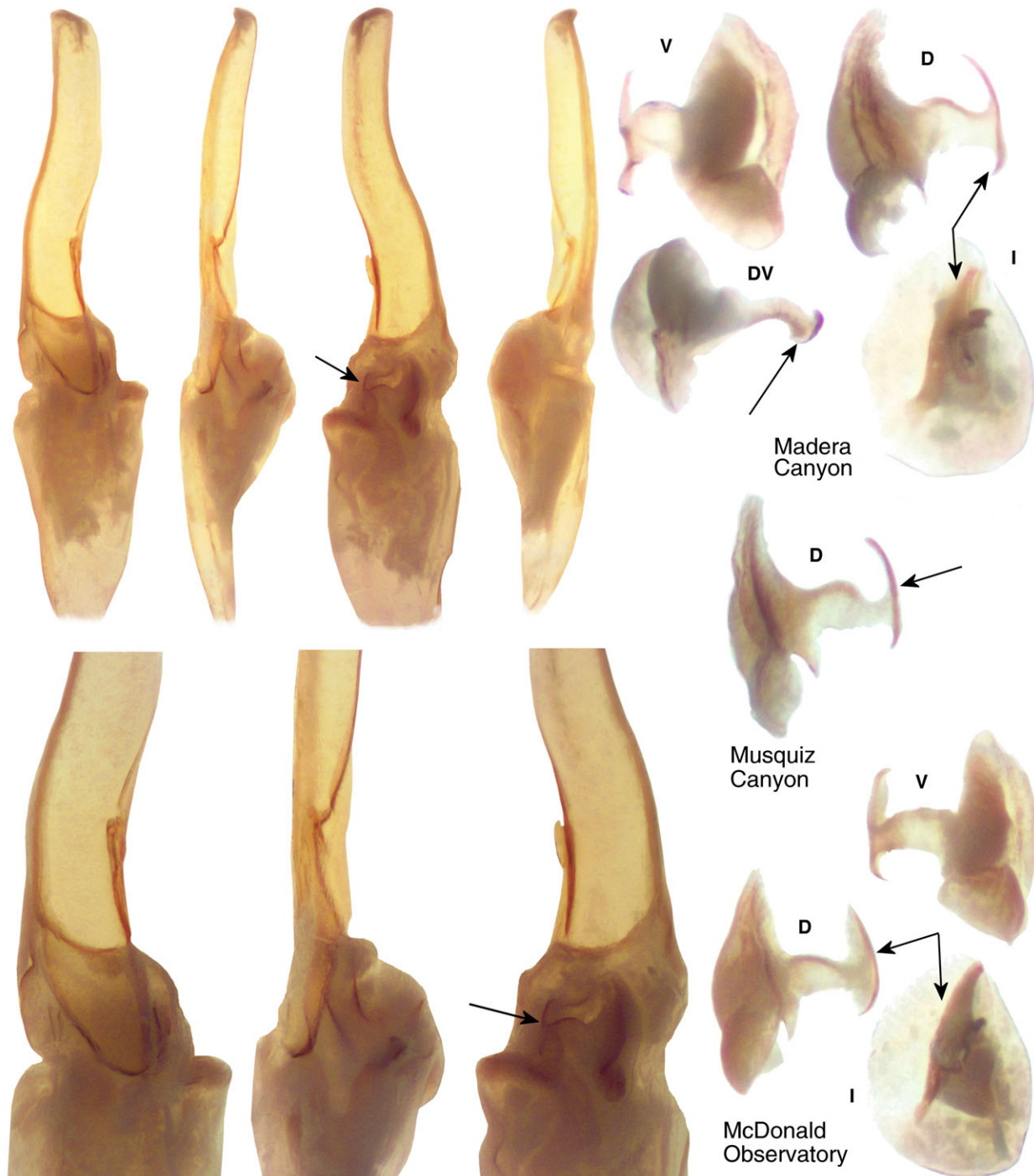


Figure 12: *Pseudouroctonus brysoni*, **sp. nov.**, male paratype, Madera Canyon, Jeff Davis Co., Texas, USA. Right hemispermatophore (photographed submerged in alcohol). **Upper-Left.** Right hemispermatophore, dorsal, internal, ventral, and exteroventral views (arrow indicates partially visible embedded mating plug). Note, subtle distal crest visible on lamina terminus, dorsal view. **Lower-Left.** Closeup of median area, dorsal, internal, and ventral views showing bifurcated lamellar hook (arrow indicates partially visible embedded mating plug). **Right.** Mating plug representing three localities as indicated (all right mating plugs except for Musquiz Canyon which is left and reversed). V = ventral, D = dorsal, I = internal, DV = distal view from lamina. Arrows point to barb's smooth edge.



Figure 13: *Pseudouroctonus brysoni* sp. nov. habitat and microhabitat in Madera Canyon, Jeff Davis County, Texas. Photos courtesy of R. W. Bryson, Jr.

	<i>Pseudouroctonus brysoni</i> , sp. nov.						
	<i>Musquiz Canyon</i>			McDonald Observatory		Madera Canyon	
	Male Holotype	Female Paratype	Male Paratype	Male Paratype	Male Paratype	Male Paratype	Male Paratype
Total length	26.55	-	21.50	21.25	24.20	21.15	20.45
Carapace length	3.50	3.50	3.10	3.10	3.30	3.10	2.90
Mesosoma length	8.50	-	5.20	5.20	6.80	5.40	5.40
Metasoma length	10.95	-	9.95	9.80	10.55	9.55	9.10
Segment I length/width	1.45/2.05	-/-	1.35/1.85	1.25/1.80	1.35/1.90	1.30/1.80	1.20/1.70
Segment II length/width	1.70/2.00	1.50/1.85	1.50/1.80	1.50/1.80	1.60/1.95	1.50/1.75	1.40/1.70
Segment III length/width	1.80/1.90	1.60/1.75	1.70/1.75	1.65/1.70	1.75/1.85	1.60/1.75	1.50/1.70
Segment IV length/width	2.30/1.80	2.05/1.70	2.00/1.70	2.10/1.65	2.20/1.80	2.00/1.65	1.90/1.60
Segment V length/width	3.70/1.85	3.30/1.65	3.40/1.65	3.30/1.60	3.65/1.80	3.15/1.60	3.10/1.55
Telson length	3.60	3.40	3.25	3.15	3.55	3.10	3.05
Vesicle length	2.40	2.25	2.15	2.10	2.25	2.00	2.00
width/depth	1.60/1.30	1.45/1.20	1.40/1.10	1.35/1.10	1.50/1.20	1.30/1.05	1.30/1.00
Aculeus length	1.20	1.15	1.10	1.05	1.30	1.10	1.05
Pedipalp length	11.10	11.20	10.15	10.05	10.65	9.65	9.35
Femur length/width	2.80/1.15	2.65/1.20	2.55/1.05	2.60/1.00	2.60/1.05	2.40/1.00	2.30/0.95
Patella length/width	2.90/1.30	2.95/1.30	2.70/1.20	2.65/1.20	2.85/1.35	2.70/1.20	2.55/1.10
Chela length	5.40	5.60	4.90	4.80	5.20	4.55	4.50
Palm length	3.00	3.10	2.75	2.60	2.80	2.50	2.40
width/depth	1.85/2.50	1.75/2.30	1.75/2.25	1.65/2.15	1.90/2.40	1.70/2.20	1.50/1.95
Fixed finger length	2.00	2.20	1.80	1.80	1.90	1.70	1.75
Movable finger length	2.85	3.00	2.55	2.55	2.80	2.45	2.40
Pectines teeth	11-11	10-10	12-12	10-10	11-10	11-11	12-12
middle lamellae	7-7	6-6	6+-6+	7-6	6-6	7-7	6+-6+
Sternum length/width	0.70/1.10	0.85/1.10	0.70/1.00	0.75/0.95	0.80/1.10	0.90/1.10	0.70/1.00

Table 1: Morphometrics (mm) of *Pseudouroctonus brysoni*, nov. sp. from three localities in Jeff Davis Co., Texas, USA.

B of the base are absent. A stem projection is present at its base.

Male and female variability. Of the seven specimens available for this study, only one is a female and deemed here to be subadult. Therefore, our comparison of the two genders is limited. Though the male has a slightly thinner metasoma in segments II–V, the MVDs (L/W) only range from 1.0 to 3.1 %. The chela fixed finger, however, is definitely shorter in the male when compared to the metasomal segment lengths which are relatively longer, in particular segments II–V, exhibiting sizable MVDs ranging from 22.4 to 25.5 %. The number of median denticles (MD) on the chelal fixed finger are essentially the same in both genders, male 48–55

(52.167) [12] and female 52–53 (52.500) [2]. Pectinal tooth counts in males exceed those of females by only one tooth, male 10–12 (11.083) [12] and female 10–10 (10.000) [2]. The genital operculum sclerites are fused medially except for the posterior one-third in the female, whereas they are separated along their entire length in the male, exposing developed genital papillae. See Appendix A for further statistical information.

Comparison of Species

The three western Texas populations of *P. brysoni* studied for this paper are located in close proximity, only 30 kilometers separate all three. The altitude of the three localities only varies 390 m. Each population is

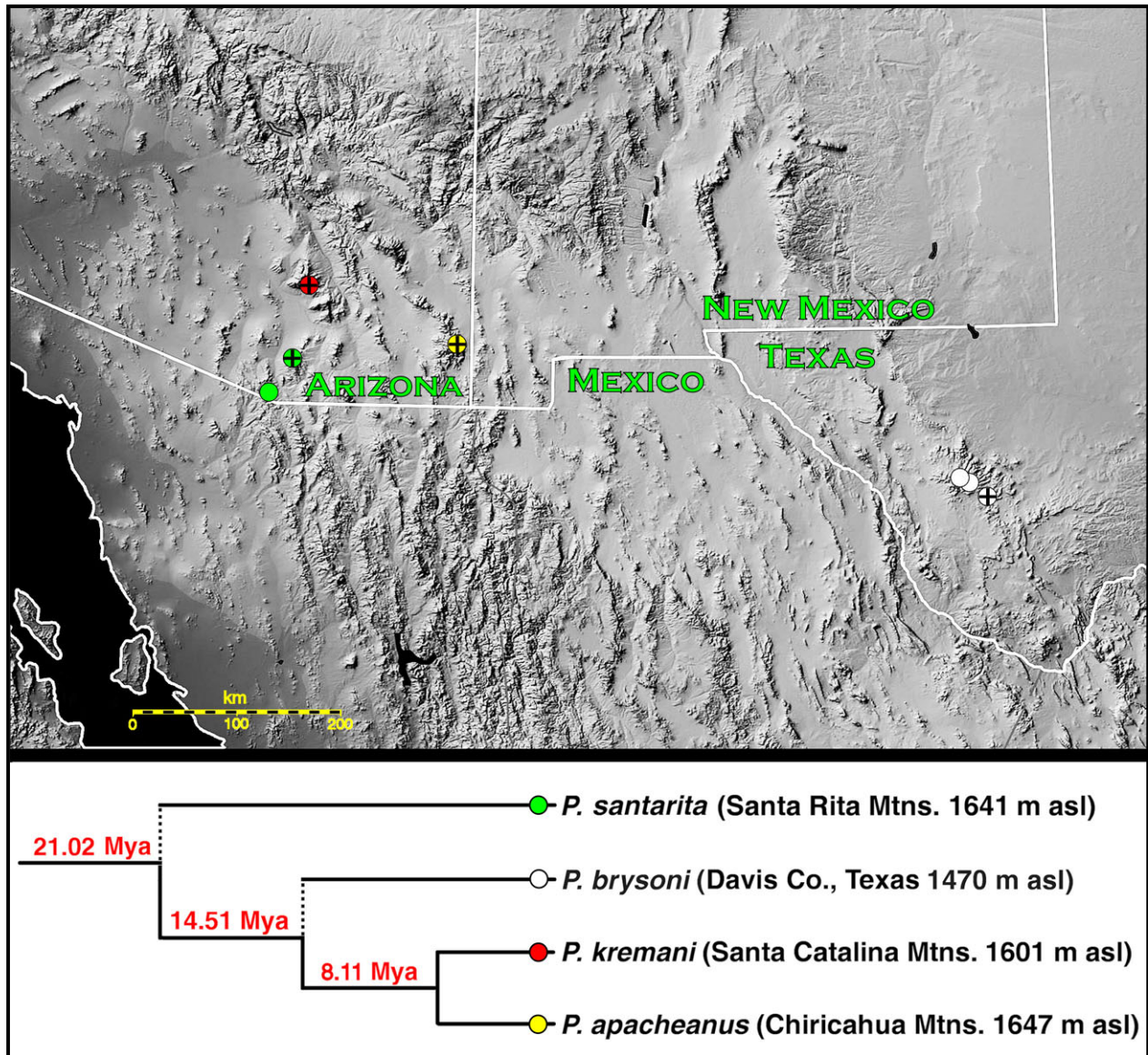


Figure 14: Proposed geographic and molecular relationships of four southwestern United States *Pseudouroctonus* species, *P. brysoni*, sp. nov. (white icon), *P. kremani* (red icon), *P. santarita* (green icon), and *P. apacheanus* (yellow icon). **Top.** Close-up of southwestern United States, showing the type localities (icon with '+') of the four species. **Bottom.** A partial chronogram based on molecular data showing proposed phylogenetic relationships based on evolutionary time indicating estimates for a multilocus species tree (red numbers depict means). Information is from Bryson et al. (2013: fig. 3). Altitude data is that of the type localities (icon with '+').

represented by two adult males each and, morphometrically, exhibit consistency in all ratio comparisons. When all possible ratios were calculated for comparison with the other three species (351 ratios in all), the coefficient of variability (i.e., sdev/mean) for *P. brysoni* was quite small, ranging only 0.002–0.059 (0.030) for the six males. This implies total consistency across the six males representing three locations for all morphometric ratio comparisons.

The four species currently placed in “*apacheanus*” group of *Pseudouroctonus*, including new species *P.*

brysoni described in this paper, are essentially structured the same. All roughly the same size, adult males 21–27 and females 29–32 mm in length, all have the same general carinal structure development with heavy granulation, and all with the same number of pectinal tooth counts, 10–12 males and 9–11 females, etc. Trichobothrial patterns are essentially identical, all exhibiting the same diagnostic positions considered in the genus. Except for the unusual brace projections exhibited on the hemispermaphore mating plug in species *P. santarita*, there are no exceptional structural differences between

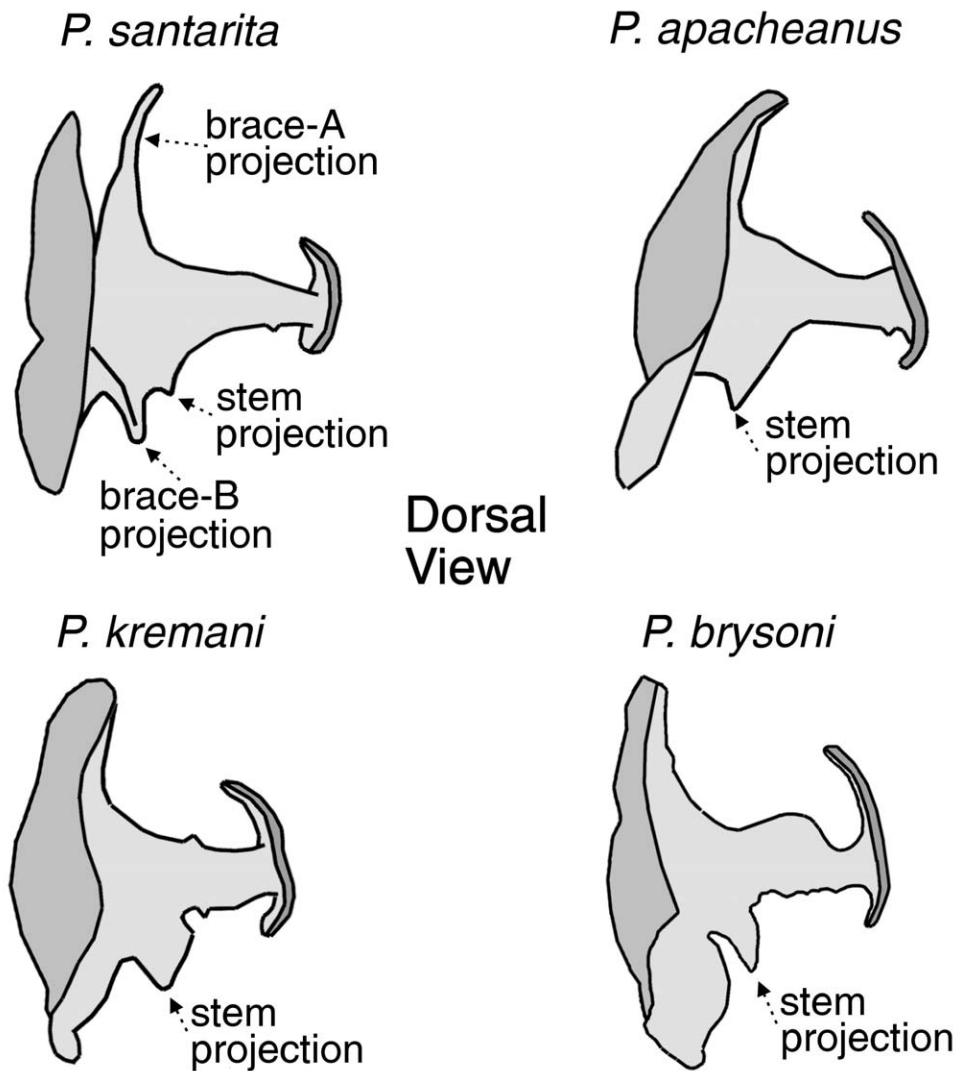


Figure 15: Diagrammatic view of the right hemispermatophore mating plug for four species of the *Pseudouroctonus* “*apacheanus*” group. The presence of brace-A and brace-B projections exhibited in species *P. santarita* is diagnostic and therefore separates it from the other three species. Based, in part, on Ayrey & Soleglad (2015: fig. 35).

the four species. Therefore, morphometric ratio comparisons are relied upon heavily to separate these four species. Also, since ratio comparisons indicate the relative length of the chelal fingers, we have also relied on the counts of median denticles (*MD*), in particular important for species with proportionally short or long chelal fingers as indicated by morphometric comparisons. Following is a key to the four species of the “*apacheanus*” group of *Pseudouroctonus*, reflecting the molecular-based phylogeny suggested by Bryson et al. (2013: fig. 3).

Key to Species of the “*apacheanus*” Group

1 — Hemispermatophore mating plug *without* projections from brace-A or brace-B of the plug base **2**

■ — Hemispermatophore mating plug with conspicuous projections from brace-A and brace-B of the plug base ***Pseudouroctonus santarita* Ayrey et Soleglad, 2011 (Santa Rita Mountains, Santa Cruz Co., Arizona, USA)**

2 — Metasomal segment V width, telson vesicle width and depth when compared to the chelal fixed finger length exhibit the following ranges: 0.67–0.76 (0.715), 0.49–0.53 (0.510), and 0.57–0.68 (0.634) **3**

■ — Metasomal segment V width, and telson vesicle width and depth when compared to the chelal fixed finger length, exhibiting the following ranges: 0.89–0.95 (0.917), 0.57–0.65 (0.615), and 0.74–0.80 (0.771) ***Pseudouroctonus brysoni*, Ayrey et Soleglad, sp. nov. (Jeff Davis Co., Texas, USA)**

3 — Hemispermatothore lamina *without* distal crest; number of median denticles (*MD*) on chelal fixed finger differ on males and females, 51–54 (52.250) for the male and 57–62 (59.667) for the female *Pseudouroctonus kremani* Ayrey et Soleglad, 2011 (Santa Catalina Mountains, Pima Co., Arizona, USA)

■ — Hemispermatothore lamina with distal crest; number of median denticles (*MD*) on chelal fixed finger are relatively large and approximately the same for males and females, 60–72 (65.167) on the male and 61–68 (64.500) on the female *Pseudouroctonus apacheanus* (Gertsch et Soleglad, 1972) (Chiricahua Mountains, Cochise Co., Arizona, USA)

As stated in the above key, species *P. santarita* is separated from the other three species by its unique hemispermatothore mating plug. Figure 15 illustrates the mating plug of the four species of the “*apacheanus*” group illustrating the unique stem brace projections, in particular brace-A and brace-B. Note, the projection from brace-A extends beyond the plug’s base. All four species do exhibit one or more stem projections, the primary being located basally on the stem. In summary, a total of eleven mating plugs were examined across the four species, all exhibiting consistency in the diagnostic characters defined in this paper (see Fig. 12 and Ayrey & Soleglad, 2015: 46).

Species Trends in the “apacheanus” group of Pseudouroctonus

Here we highlight morphological “trends” of the four species based primarily on the data contained in Appendix A.

***P. brysoni*:** Hemispermatothore mating plug lacks the projections from the stem’s brace-A and brace-B. The distal crest found on the hemispermatothore’s lamina terminus (dorsal view) is present in this species. Exhibits the heaviest metasoma segments II–V (male only considered, length compared to width) but with only large MVD separation with species *P. kremani*, species with the thinnest metasoma, ranging 12.4 to 19.0 percent. Telson width and depth is the heaviest when compared to the relatively short chelal fixed finger, in particular when compared to species *P. kremani* and *P. apacheanus*, exhibiting large MVDs ranging 20.0 to 22.5 percent.

***P. kremani*:** Hemispermatothore mating plug lacks the projections from the stem’s brace-A and brace-B. The distal crest found on the hemispermatothore’s lamina terminus (dorsal view) is absent in this species. The crest is modest in the other three species. Exhibits the thinnest metasoma segments II–V (male only considered, length compared to width) but with only large

MVD separation with species *P. brysoni* as discussed above. The number of median denticles (*MD*) located on the chelal fixed finger is considerably larger in the female than in the male, exhibiting a 14.2 % difference in the MVD.

***P. apacheanus*:** Hemispermatothore mating plug lacks the projections from the stem’s brace-A and brace-B. The distal crest found on the hemispermatothore’s lamina terminus (dorsal view) is present in this species. Exhibits the largest number of median denticles (*MD*) on the chelal fixed finger, 60–72 (65.167) for the male and 61–68 (64.500) for the female. This is due, in most part, to its relatively long chelal fingers.

***P. santarita*:** Hemispermatothore mating plug exhibits conspicuous projections from the stem’s brace-A and brace-B, a major diagnostic character. The distal crest found on the hemispermatothore’s lamina terminus (dorsal view) is present in this species. Exhibits the smallest number of median denticles (*MD*) on the chelal fixed finger, 46–50 (48.667) for the male and 47–53 (49.500) for the female. This is due, in most part, to its relatively short chelal fingers.

Acknowledgments

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Appendix A

Statistical results of the morphometric ratio and meristic analysis conducted in this paper are presented in this appendix. Data is presented as follows: minimum–maximum (mean) (\pm standard deviation) [number of samples] {mean: plus–minus standard deviation} (coefficient of variability). Species are ordered by increasing mean values. Species *Pseudouroctonus brysoni* **sp. nov.** is highlighted with **bold** lettering. Note, due to the subadult status of the only female specimen of *P. brysoni* available, morphometric ratio data presented here is based on *males only*. Data is also presented which shows key measurements and morphometric ratios for the hemispermaphore of the four species.

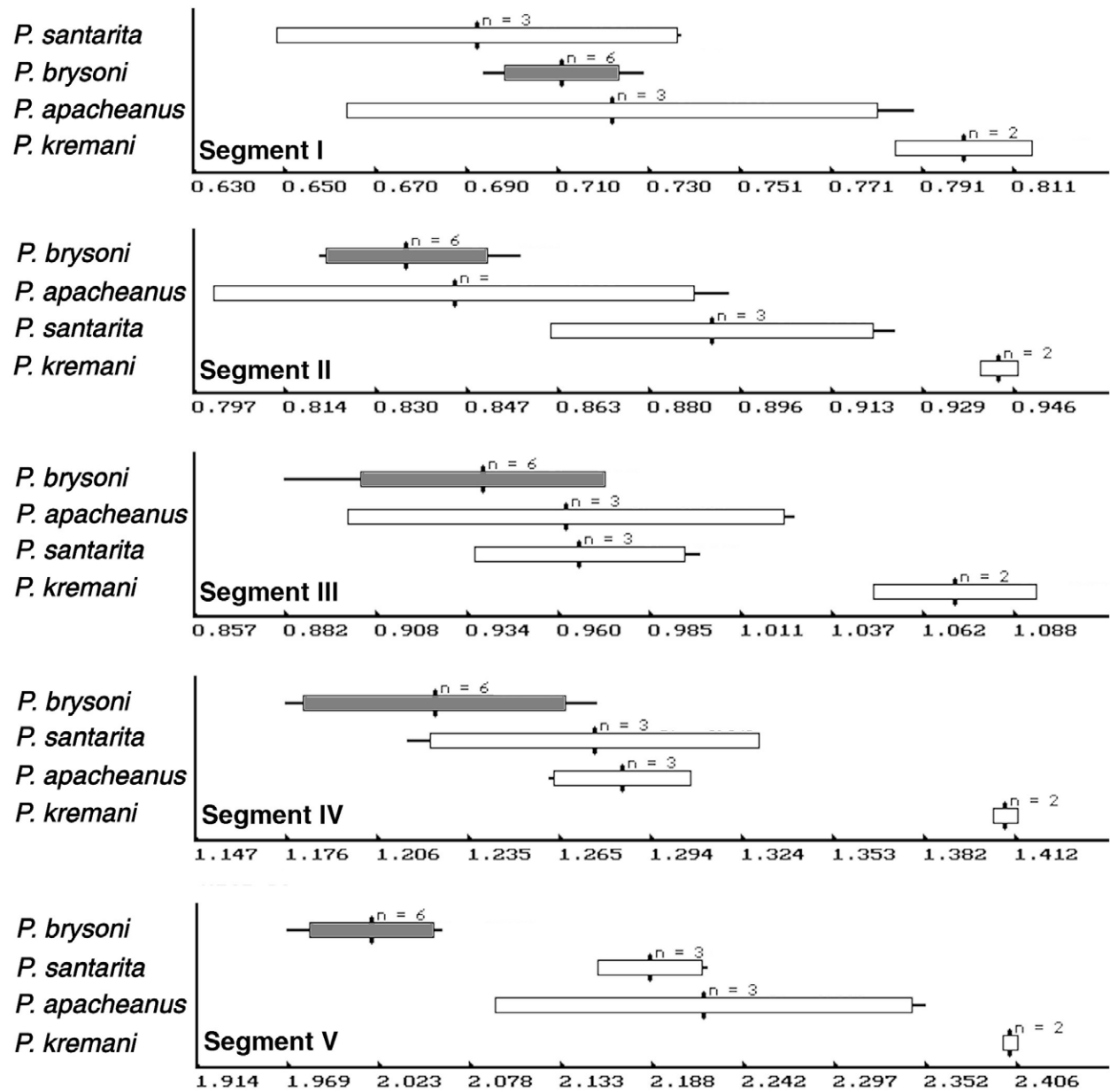


Figure A-1: Histogram showing morphometric ratio result of metasomal segment's length as compared to its width. Data represents male specimens only. *Pseudouroctonus brysoni* sp. nov. is indicated with shaded bar.

Metasoma Segment L/W

Segment I

<i>P. santarita</i>	0.65–0.74 (0.693) (± 0.044) [3]	{0.65–0.74}	0.064
<i>P. brysoni</i>	0.69–0.73 (0.712) (± 0.013) [6]	{0.70–0.72}	0.018
<i>P. apacheanus</i>	0.68–0.79 (0.723) (± 0.058) [3]	{0.66–0.78}	0.081
<i>P. kremani</i>	0.79–0.81 (0.800) (± 0.015) [2]	{0.79–0.82}	0.019

Segment II

<i>P. brysoni</i>	0.82–0.86 (0.836) (± 0.015) [6]	{0.82–0.85}	0.017
<i>P. apacheanus</i>	0.81–0.89 (0.845) (± 0.044) [3]	{0.80–0.89}	0.052
<i>P. santarita</i>	0.87–0.93 (0.892) (± 0.029) [3]	{0.86–0.92}	0.033
<i>P. kremani</i>	0.94–0.95 (0.944) (± 0.003) [2]	{0.94–0.95}	0.004

Segment III

<i>P. brysoni</i>	0.88–0.97 (0.939) (± 0.035) [6]	{0.90–0.97}	0.037
<i>P. apacheanus</i>	0.90–1.03 (0.962) (± 0.061) [3]	{0.90–1.02}	0.064
<i>P. santarita</i>	0.95–1.00 (0.966) (± 0.030) [3]	{0.94–1.00}	0.031
<i>P. kremani</i>	1.06–1.09 (1.072) (± 0.023) [2]	{1.05–1.10}	0.022

Segment IV

<i>P. brysoni</i>	1.18–1.28 (1.225) (± 0.042) [6]	{1.18–1.27}	0.035
<i>P. santarita</i>	1.22–1.32 (1.276) (± 0.053) [3]	{1.22–1.33}	0.041
<i>P. apacheanus</i>	1.26–1.31 (1.286) (± 0.022) [3]	{1.26–1.31}	0.017
<i>P. kremani</i>	1.41–1.41 (1.409) (± 0.004) [2]	{1.41–1.41}	0.003

Segment V

<i>P. brysoni</i>	1.97–2.06 (2.020) (± 0.037) [6]	{1.98–2.06}	0.018
<i>P. santarita</i>	2.16–2.22 (2.187) (± 0.031) [3]	{2.16–2.22}	0.014
<i>P. apacheanus</i>	2.11–2.35 (2.219) (± 0.125) [3]	{2.09–2.34}	0.056
<i>P. kremani</i>	2.40–2.41 (2.403) (± 0.004) [2]	{2.40–2.41}	0.002

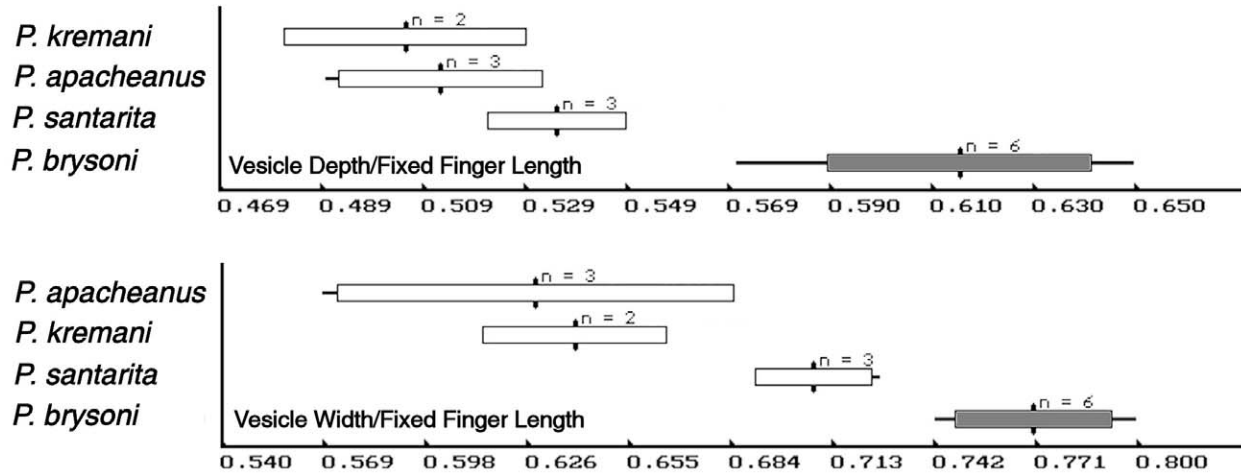


Figure A-2: Histogram showing morphometric ratio result of telson vesicle width and depth as compared to fixed finger length. Data represents male specimens only. *Pseudouroctonus brysoni* sp. nov. is indicated with shaded bar.

Telson/Chelal Fixed Finger

Telson_D/FF_L

<i>P. kremani</i>	0.49–0.52 (0.506) (±0.024) [2]	{0.48–0.53} 0.047
<i>P. apacheanus</i>	0.49–0.53 (0.513) (±0.020) [3]	{0.49–0.53} 0.039
<i>P. santarita</i>	0.52–0.55 (0.536) (±0.014) [3]	{0.52–0.55} 0.025
<i>P. brysoni</i>	0.57–0.65 (0.615) (±0.026) [6]	{0.59–0.64} 0.043

Telson_W/FF_L

<i>P. apacheanus</i>	0.57–0.68 (0.629) (±0.056) [3]	{0.57–0.69} 0.089
<i>P. kremani</i>	0.62–0.66 (0.641) (±0.026) [2]	{0.61–0.67} 0.041
<i>P. santarita</i>	0.70–0.73 (0.708) (±0.016) [3]	{0.69–0.72} 0.023
<i>P. brysoni</i>	0.74–0.80 (0.771) (±0.022) [6]	{0.75–0.79} 0.029

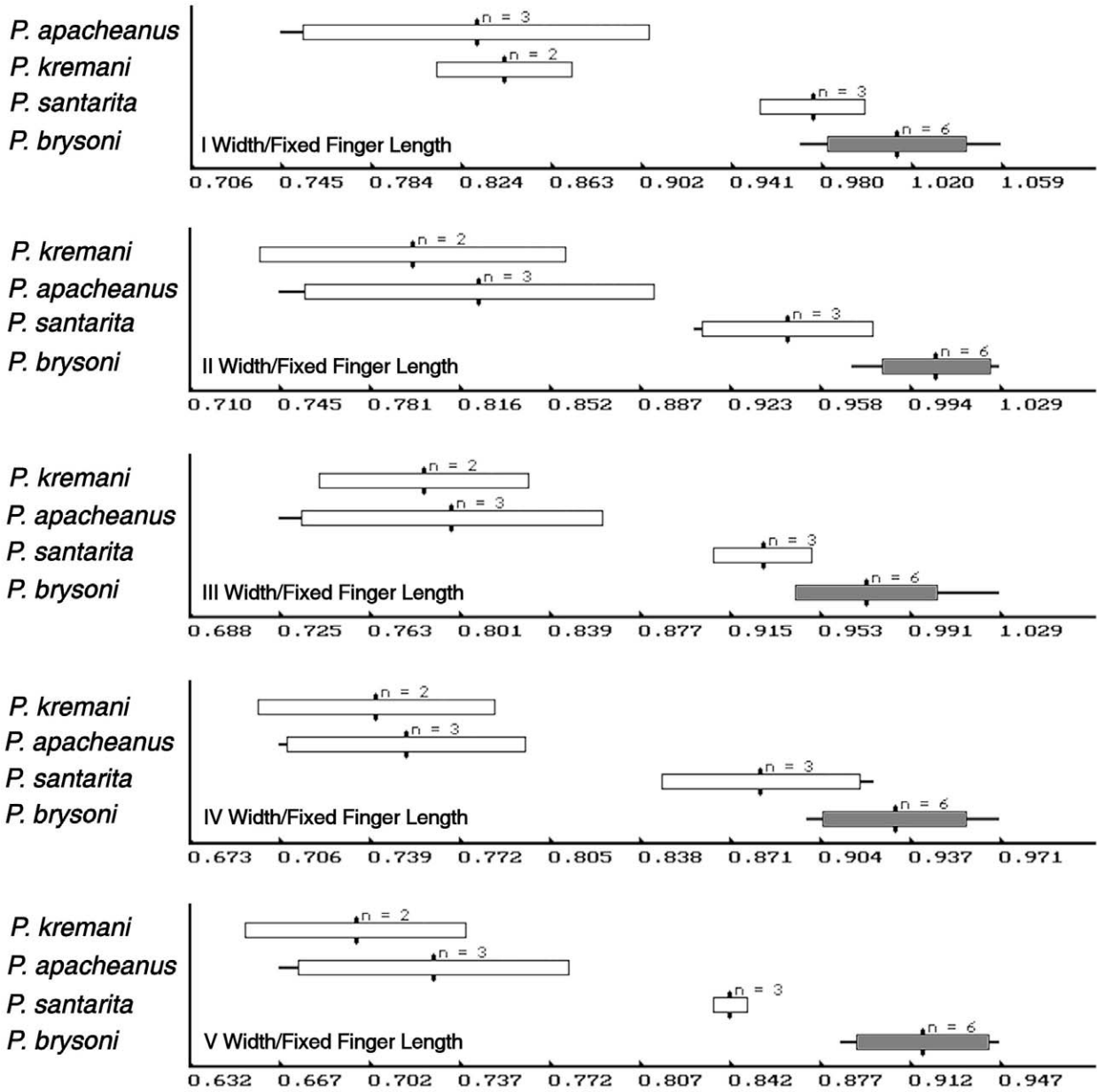


Figure A-3: Histogram showing morphometric ratio result of metasomal segments width as compared to fixed finger length. Data represents male specimens only. *Pseudouroctonus brysoni* sp. nov. is indicated with shaded bar.

Metasoma Segment Width/Chelal Fixed Finger Length

Segment I

<i>P. apacheanus</i>	0.75–0.89 (0.831) (± 0.075) [3]	{0.76–0.91} 0.091
<i>P. kremani</i>	0.82–0.86 (0.843) (± 0.029) [2]	{0.81–0.87} 0.035
<i>P. santarita</i>	0.95–1.00 (0.977) (± 0.023) [3]	{0.95–1.00} 0.023
<i>P. brysoni</i>	0.97–1.06 (1.014) (± 0.030) [6]	{0.98–1.04} 0.030

Segment II

<i>P. kremani</i>	0.76–0.84 (0.798) (± 0.060) [2]	{0.74–0.86} 0.076
<i>P. apacheanus</i>	0.75–0.87 (0.824) (± 0.069) [3]	{0.76–0.89} 0.083
<i>P. santarita</i>	0.91–0.98 (0.946) (± 0.034) [3]	{0.91–0.98} 0.036
<i>P. brysoni</i>	0.97–1.03 (1.005) (± 0.021) [6]	{0.98–1.03} 0.021

Segment III

<i>P. kremani</i>	0.76–0.82 (0.787) (± 0.044) [2]	{0.74–0.83} 0.056
<i>P. apacheanus</i>	0.73–0.84 (0.799) (± 0.063) [3]	{0.74–0.86} 0.079
<i>P. santarita</i>	0.91–0.95 (0.930) (± 0.020) [3]	{0.91–0.95} 0.022
<i>P. brysoni</i>	0.94–1.03 (0.974) (± 0.030) [6]	{0.94–1.00} 0.031

Segment IV

<i>P. kremani</i>	0.71–0.77 (0.742) (± 0.044) [2]	{0.70–0.79} 0.059
<i>P. apacheanus</i>	0.71–0.79 (0.753) (± 0.044) [3]	{0.71–0.80} 0.058
<i>P. santarita</i>	0.86–0.93 (0.883) (± 0.036) [3]	{0.85–0.92} 0.041
<i>P. brysoni</i>	0.90–0.97 (0.932) (± 0.026) [6]	{0.91–0.96} 0.028

Segment V

<i>P. kremani</i>	0.67–0.73 (0.697) (± 0.043) [2]	{0.65–0.74} 0.061
<i>P. apacheanus</i>	0.67–0.76 (0.727) (± 0.052) [3]	{0.67–0.78} 0.072
<i>P. santarita</i>	0.84–0.85 (0.843) (± 0.007) [3]	{0.84–0.85} 0.008
<i>P. brysoni</i>	0.89–0.95 (0.917) (± 0.026) [6]	{0.89–0.94} 0.028

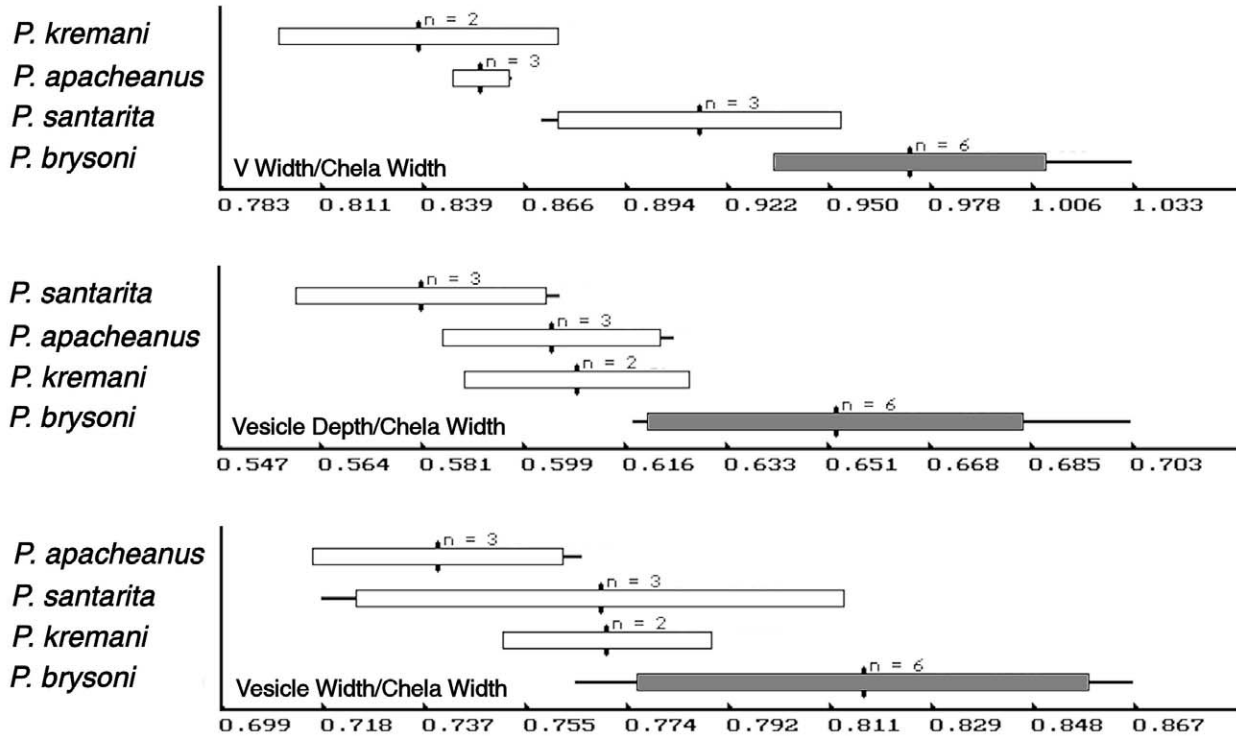


Figure A-4: Histogram showing morphometric ratio result of telson vesicle width and depth, and metasomal segment V width as compared to chela width. Data represents male specimens only. *Pseudouroctonus brysoni* sp. nov. is indicated with shaded bar.

Chela Palm Width/Telson and Metasoma V Width

Segment V_W/CW

<i>P. kremani</i>	0.81–0.86 (0.838) (±0.038) [2]	{0.80–0.88} 0.046
<i>P. apacheanus</i>	0.85–0.86 (0.855) (±0.008) [3]	{0.85–0.86} 0.009
<i>P. santarita</i>	0.87–0.95 (0.915) (±0.039) [3]	{0.88–0.95} 0.042
<i>P. brysoni</i>	0.94–1.03 (0.972) (±0.037) [6]	{0.94–1.01} 0.038

Telson_D/CW

<i>P. santarita</i>	0.56–0.61 (0.581) (±0.021) [3]	{0.56–0.60} 0.037
<i>P. apacheanus</i>	0.59–0.62 (0.604) (±0.018) [3]	{0.59–0.62} 0.031
<i>P. kremani</i>	0.59–0.62 (0.608) (±0.019) [2]	{0.59–0.63} 0.031
<i>P. brysoni</i>	0.62–0.70 (0.652) (±0.032) [6]	{0.62–0.68} 0.049

Telson_W/CW

<i>P. apacheanus</i>	0.73–0.77 (0.739) (±0.023) [3]	{0.72–0.76} 0.031
<i>P. santarita</i>	0.72–0.80 (0.769) (±0.045) [3]	{0.72–0.81} 0.058
<i>P. kremani</i>	0.76–0.78 (0.770) (±0.019) [2]	{0.75–0.79} 0.025
<i>P. brysoni</i>	0.76–0.87 (0.817) (±0.041) [6]	{0.78–0.86} 0.051

Mean Value Differences (MVD %) for All Histograms (Males Only)
(values of 10 % or more are highlighted)

	<i>P. brysoni</i>	<i>P. apacheanus</i>	<i>P. kremani</i>	<i>P. santarita</i>
<i>P. brysoni</i>				
C1:L/W	-	1.5	12.4	2.7
C2:L/W	-	1.1	12.9	6.7
C3:L/W	-	2.4	14.2	2.9
C4:L/W	-	5.0	15.0	4.2
C5:L/W	-	9.9	19.0	8.3
C1W/FFL	-	22.0	20.3	3.8
C2W/FFL	-	22.0	25.8	6.2
C3W/FFL	-	21.9	23.7	4.7
C4W/FFL	-	23.8	25.7	5.5
C5W/FFL	-	26.1	31.6	8.8
TD/FFL	-	20.0	21.7	14.9
TW/FFL	-	22.5	20.3	8.8
C5W/CW	-	13.7	16.0	6.3
TD/CW	-	11.8	7.2	12.2
TW/CW	-	10.6	6.1	6.3
<i>P. apacheanus</i>				
C1:L/W	-	-	10.7	4.3
C2:L/W	-	-	11.7	5.6
C3:L/W	-	-	11.4	0.0
C4:L/W	-	-	9.6	5.0
C5:L/W	-	-	8.3	1.5
C1W/FFL	-	-	1.0	17.6
C2W/FFL	-	-	3.2	18.5
C3W/FFL	-	-	2.0	16.4
C4W/FFL	-	-	1.5	17.3
C5W/FFL	-	-	4.3	15.9
TD/FFL	-	-	1.4	4.5
TW/FFL	-	-	1.8	12.6
C5W/CW	-	-	2.0	7.0
TD/CW	-	-	1.0	4.0
TW/CW	-	-	4.2	4.1
<i>P. kremani</i>				
C1:L/W	-	-	-	15.4
C2:L/W	-	-	-	5.8
C3:L/W	-	-	-	11.0
C4:L/W	-	-	-	10.4
C5:L/W	-	-	-	9.9
C1W/FFL	-	-	-	15.9
C2W/FFL	-	-	-	18.5
C3W/FFL	-	-	-	18.2
C4W/FFL	-	-	-	19.0
C5W/FFL	-	-	-	20.9
TD/FFL	-	-	-	5.9
TW/FFL	-	-	-	10.5
C5W/CW	-	-	-	9.2
TD/CW	-	-	-	4.6
TW/CW	-	-	-	0.0

Fixed Finger Median Denticle (MD) Statistics

<i>P. santarita</i> :	
Male:	46–50 (48.667) (± 1.506) [06] {47.161–50.172} (0.031)
Female:	47–53 (49.500) (± 2.070) [08] {47.430–51.570} (0.042)
<i>P. brysoni</i> :	
Male:	48–55 (52.167) (± 2.368) [12] {49.799–54.534} (0.045)
Female:	52–53 (52.500) (± 0.707) [02] {51.793–53.207} (0.013)
<i>P. kremani</i> :	
Male:	51–54 (52.250) (± 1.258) [04] {50.992–53.508} (0.024)
Female:	57–62 (59.667) (± 1.751) [06] {57.916–61.418} (0.029)
<i>P. apacheanus</i> :	
Male:	60–72 (65.167) (± 4.622) [06] {60.544–69.789} (0.071)
Female:	61–68 (64.500) (± 2.258) [06] {62.242–66.758} (0.035)

Pectinal Tooth Count Ranges

	Male	Female
<i>P. apacheanus</i> :	10–12 (10.600) (± 0.699) [10]	9–11 (9.722) (± 0.575) [18]
<i>P. santarita</i> :	10–12 (11.000) (± 0.555) [14]	8–10 (9.000) (± 0.378) [29]
<i>P. brysoni</i> :	10–12 (11.083) (± 0.793) [12]	10–10 (10.000) (± 0.000) [02]
<i>P. kremani</i> :	11–12 (11.214) (± 0.426) [14]	9–10 (9.469) (± 0.507) [32]

The pectinal tooth counts presented above are based on specimens analysed as well as data reported, in part, by Ayrey & Soleglad (2011: Appendix B, p. 53).

	Hemi_L	Lamina_L	L_Hook_L	Trough_Diff	L_Hook_L/ Lamina_L	Trough_Diff/ L_Hook_L
<i>P. apacheanus</i>	4.70	2.70	1.15	0.60	0.426	0.522
	4.80	2.80	1.20	0.55	0.429	0.458
	4.70–4.80	2.70–2.80	1.15–1.20	0.55–0.60	0.426–0.429	0.458–0.522
<i>P. brysoni</i>	4.40	2.50	0.90	0.50	0.360	0.556
	-	2.40	1.00	0.50	0.417	0.500
	-	2.40	1.00	0.55	0.417	0.550
	4.20	2.50	1.05	0.50	0.420	0.476
	4.20–4.40	2.40–2.50	0.90–1.05	0.50–0.55	0.360–0.420	0.476–0.556
<i>P. kremani</i>	-	-	-	-	-	-
	-	2.50	1.00	0.50	0.400	0.500
	-	2.50–2.50	1.00–1.00	0.50–0.50	0.400–0.400	0.500–0.500
<i>P. santarita</i>	3.50	2.40	0.95	0.44	0.396	0.463
	-	2.40	0.90	0.45	0.375	0.500
	3.50–3.50	2.40–2.40	0.90–0.95	0.44–0.45	0.375–0.396	0.463–0.500
	3.50–4.80 [5]	2.40–2.80 [9]	0.90–1.20 [9]	0.44–0.60 [9]	0.360–0.429 [9]	0.458–0.556 [9]

Table A-1: Key measurements of the hemispermatophore (mm) and two morphometric ratios are presented in this table. Hemi_L = hemispermatophore length, Lamina_L = lamina length, L_Hook_L = lamellar hook length, Trough_Diff = trough difference. See Soleglad & Fet (2008: fig. 40) for methods of measurement.