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DESCRIPTION OF THE MALE OF *AVICULARIA RICKWESTI* BERTANI & HUFF, 2013, A REMARKABLE SPECIES FROM THE DOMINICAN REPUBLIC (ARANEAE: THERAPHOSIDAE: AVICULARIINAE)

Radan Kaderka

Tyrsovo namesti 1732, 252 63 Roztoky u Prahy, Czech Republic. — radan.kaderka@seznam.cz

Abstract: A male of *Avicularia rickwesti* Bertani & Huff, 2013 from Pedernales province, Dominican Republic in the Greater Antillean island of Hispaniola is, herein, described and figured. The males of *Avicularia rickwesti* differ from all other congeners by the presence of well-developed keels on the embolus of the palpal bulb. The species is rediagnosed.
Key words: Araneae, Mygalomorphae, Theraphosidae, taxonomy, Central America, Caribbean, Greater Antilles.

Descripción del macho de *Avicularia rickwesti* Bertani & Huff, 2013, una especie curiosa de la República Dominicana (Araneae: Theraphosidae: Aviculariinae)
Resumen: Se describe e ilustra un macho de *Avicularia rickwesti* Bertani & Huff, 2013 de la provincia Pedernales, República Dominicana, la isla de la Española, Antillas Mayores. Los machos de *Avicularia rickwesti* se diferencian del resto de sus congéneres por presentar quillas en el émbolo del bulbo palpal. La especie se rediagnostica.
Palabras clave: Araneae, Mygalomorphae, Theraphosidae, taxonomía, America Central, Caribe, Antillas Mayores.

Introduction

In 1818, Lamarck established the genus Avicularia to accommodate several big theraphosids: *Avicularia canceridea* (Latreille, 1806) from the Antilles, with *Aranea avicularia* Linnaeus, 1758 as a senior synonym, *Avicularia blondii* (Latreille, 1804) from Cayenne in French Guyana and *Avicularia fasciata* (Latreille, 1804) from Ceylon. He characterized the new genus by the well-developed palps, shorter than legs, the chelicerae without rastellum but with a tooth on inferior side, the indistinct labium, eight eyes arranged in X-shape, the great body with eight strong legs and the distal articles of their tarsi underneath with a downy comb. The reason for that synonymization of *A. avicularia* with *A. canceridea* remains unclear. Simon (1892) proposed a new diagnosis for *Avicularia*, based on the almost equal anterior eyes forming a procurved line and the presence of inner apical apophysis on anterior tibia in males which is rounded and covered with numerous spines. In 1923, Mello-Leitão proposed a different diagnosis for the genus *Avicularia*, based on the absence of apophysis on leg II in males, posterior legs longer than anterior ones and uniformly coloured abdomen. Raven (1985) emphasized in *Avicularia* only the strongly procurved anterior row of eyes in his key to Aviculariinae genera and the absence of apophysis on leg II in males. Later, Gallon (2008) used the presence of abdominal urticating setae of type II to diagnose the genus *Avicularia*, distinguishing it from *Iridopelma* Pocock, 1901 by the absence of apophysis on tibia II, leg IV longer than leg I and by spermathecae divergently curved with unlobed termini, in contrary to the single-lobed termini present in *Iridopelma*. The author also pointed out that the anterior row of eyes (ALE-AME-AME-ALE) is strongly procurved in *Avicularia*, but weakly procurved in *Pachistopelma* Pocock, 1901.

At present the genus *Avicularia* which inhabits the Neotropical region (Figure 1), comprises 49 species (World Spider Catalog, 2016), of which 42 are from South America. A single species, *A. glauca* Simon, 1891, was described from Panama, in Central America, and five from the Carribean, from Greater and Lesser Antilles: *A. rickwesti* Bertani & Huff, 2013 from Dominican Republic, *A. laeta* (C. L. Koch, 1842) and *A. caesia* (C. L. Koch, 1842) from Puerto Rico, *A. versicolor* (Walckenaer, 1837) from Martinique and Guadeloupe and *A. hirsuta* (Ausserer, 1875) from Cuba. At least one species, *A. affinis* (Nicolet, 1849) from Santiago de Chile, is misplaced in that genus according to the original description. *A. caesia* is considered a synonym of *A. laeta* by some authors (Braunshausen, 1995; Schmidt, 2003), mostly due to the same origin of both species, small size and coloration of the type of *A. caesia* with the total body length only 9.5 mm (6´´´) and the typical striped abdominal pattern, in dark grey-blue combination, known from juvenile specimens of other *Avicularia* species. In contrary to this, the type of *A. laeta* has the total body length 25.4 mm (1´´) and greyish brown coloration (Koch, 1842).

In 2014, I received male and female topotype of *Avicularia rickwesti* from Dominican Republic, Pedernales province, both preserved in alcohol. The females of this species have spermathecae consisting of two very short and broad receptacles, unusual among *Avicularia* species, with distal half strongly sclerotized (Bertani & Huff, 2013: figure 2). The male was hitherto unknown. The male specimen of *A. rickwesti* with unusual morphology of palpal bulb carrying keels is here described and figured for the first time. A new diagnosis of this species is proposed.

Material and methods

Measurements were taken with an ocular micrometer of a binocular microscope Leica S6D according to the central axis of structures and are given in millimetres. The measurements of the leg and palpal segments were taken dorsally. The eye measurements were taken from the widest spans of the lens, AME in dorsal view, ALE, PLE and PME in dorsolateral



Figure 1. Distribution map of the genus *Avicularia* in Central and South America, in grey (based on the data from World Spider Catalog, 2016). This area also represents the distribution range of avicullariinae with abdominal urticating setae of the type II.

view. The measurement of the total body length including cephalothorax and abdomen without spinnerets was made using a calliper.

The extent of tarsal and metatarsal scopulae on ventral side of both leg segments was expressed as a percentage of the total length of segment, from apical end.

The terminology of male palpal bulb structures follows Bertani (2000). The description of keels in *Avicularia rickwesti* follows the arrangement of keels in *Brachypelma emilia* (White, 1856) (Bertani, 2001: figures 155-156).

The abdominal urticating setae were removed from the area of urticating setae by pincette, placed in alcohol and examined by a binocular microscope Leica S6D. The terminology of urticating setae follows Cooke *et al*. (1972).

The denticulation of chelicerae is described separately for right and left chelicera, from basal to apical end. The teeth in row are categorized according to its relative size into two categories, the small teeth are marked by "v", big teeth by "V". E.g. the record "V-v-V-v-V-V-VVV" means that chelicera has seven big and two small teeth, between the last three apical teeth there is no distinct space. The description of cheliceral denticulation may be complemented by a range of microspikes (granulation) near basal teeth.

Specimens studied herein are preserved in ethanol 70% and deposited in the collection of NMPC and RKCP.

Abbreviations: Eye sizes and interdistances: AME = anterior median eyes, ALE = anterior lateral eyes, PME = posterior median eyes, PLE = posterior lateral eyes, OQ = ocular quadrangle (including lateral eyes). Male palpal bulb: PS = prolateral superior keel, PI = prolateral inferior keel, A = apical keel. Cheliceral teeth pattern: v = small teeth, V = big teeth, - = space. PLS = posterior lateral spinnerets, PMS = posterior median spinnerets. AMNH = American Museum of Natural History, New York; NMPC = National Museum, Natural History Department, Praha, Czech Republic; RKCP = Radan Kaderka collection, Prague, Czech Republic.

Taxonomy

Order: Araneae Clerck, 1757
Infraorder: Mygalomorphae Pocock, 1892
Family: Theraphosidae Thorell, 1869
Subfamily: Avicullariinae Simon, 1873
Genus: *Avicularia* Lamarck, 1818

TYPE SPECIES: *Avicularia avicularia* (Linnaeus, 1758)

DIAGNOSIS: *Avicularia* differs from all known theraphosid genera, except for *Iridopelma* Pocock, 1901, *Pachistopelma* Pocock, 1901 and *Typhochlaena* C. L. Koch, 1850, in the presence of type II urticating setae on dorsal abdomen, in combination with spinose or weakly spinose legs, tarsi and metatarsi I and II laterally extended and with none or one subapical process on male tibia I, covered with numerous spines.

Avicularia differs from *Iridopelma* in the absence of tibial process on leg II in males and in females in spermathecae having accentuated curvature medially, except for *Avicularia rickwesti* having short and broad spermathecae, twice wider than longer, with distal half strongly sclerotized; from *Pachistopelma* in the anterior eye row strongly procurved; from *Typhochlaena* in the presence of digitiform apical segment of PLS, the presence of subapical apophysis on tibia I, except for *Avicularia diversipes* (C. L. Koch, 1842), *A. gamba* Bertani & Fukushima, 2009, *A. sooretama* Bertani & Fukushima, 2009, and in the presence of spiniform process on cymbium in males, except for *A. gamba* lacking spiniform process (modified from Bertani & Fukushima, 2009; Bertani, 2012).

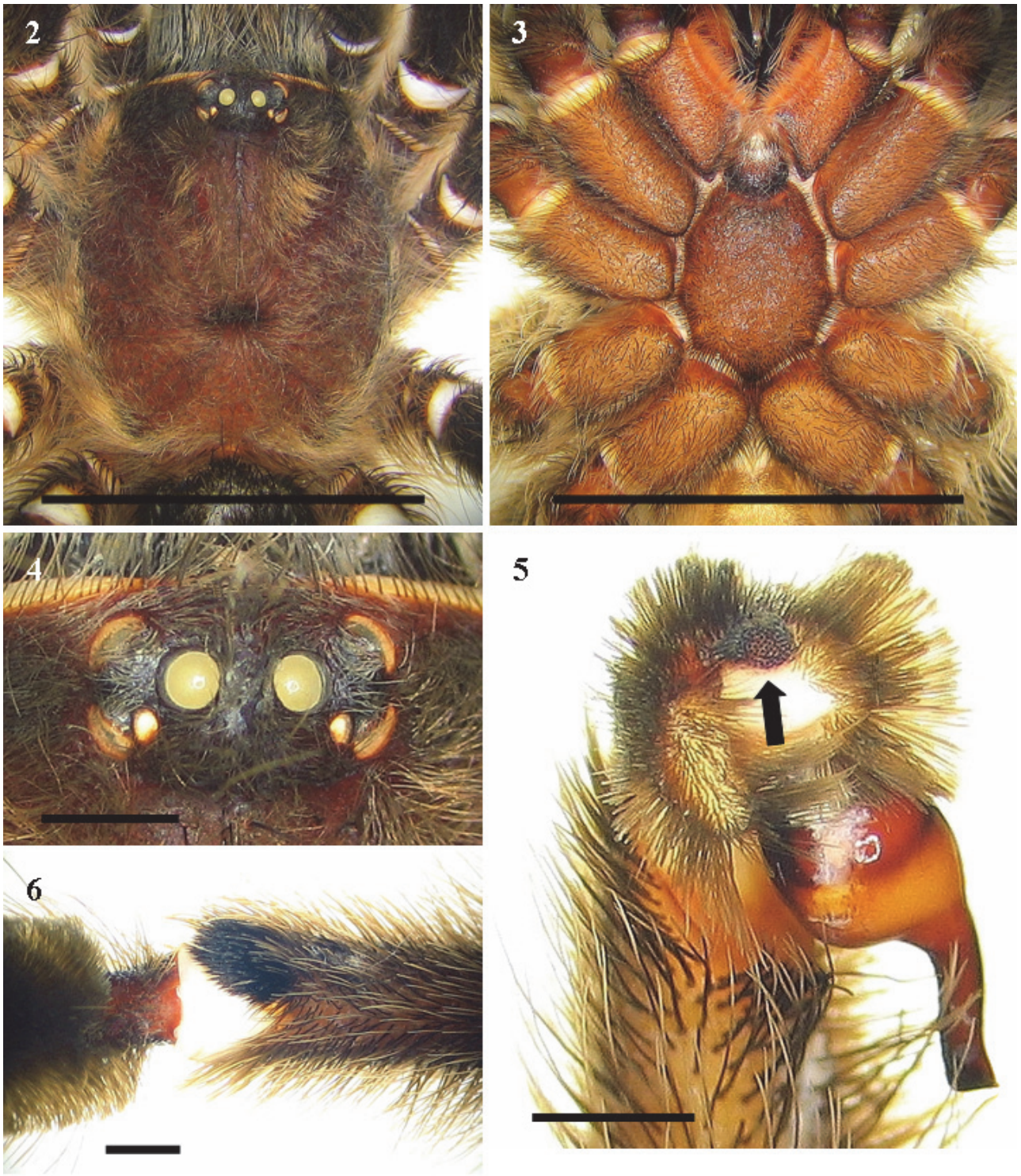
DISTRIBUTION: see Figure 1.

Avicularia rickwesti Bertani & Huff, 2013

Figures 2-11, Table I.

Avicularia rickwesti: Bertani & Huff, 2013: 333-337, figures 2-19. Female holotype (AMNH) from Dominican Republic, Pedernales province, Parque Nacional Jaragua, track into park between Manuell Goa and Oviedo, 17°48'41.5"N, 71°26'35.9"W, altitude 83.3 m a.s.l., July 9, 2004, J. Huff & E. S. Volschenk col. (not examined), female paratype (AMNH) from Dominican Republic, Independencia province, Parque Nacional Sierra de Baoruco, Rabo de Gato, 18°18'39.1"N, 71°34'54.4"W, altitude 408 m a.s.l., July 10, 2004, J. Huff & E. S. Volschenk col. (not examined).

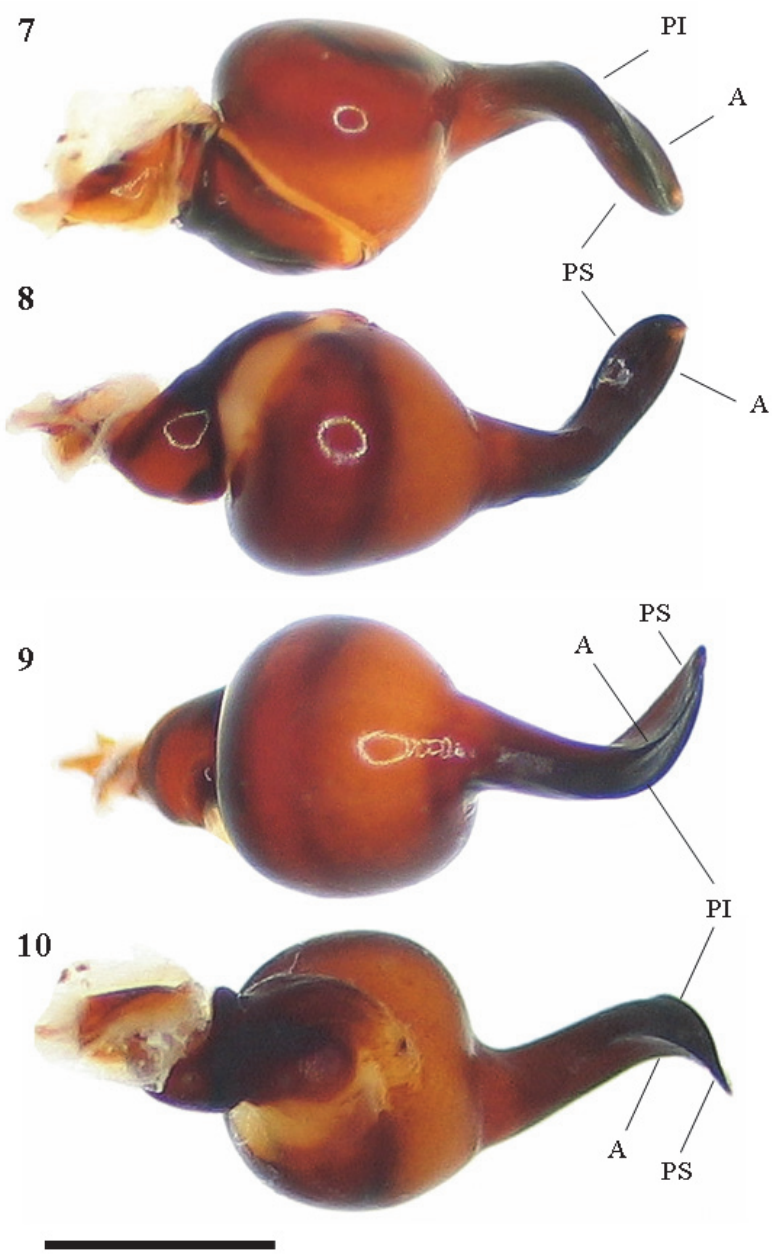
DIAGNOSIS: Females of *Avicularia rickwesti* distinguish from all other congeners by the two very short and broad spermathecae, twice wider than longer, with distal half strongly sclerotized. Additionally, it can be distinguished by the leg coxae with spiniform setae; small on leg I and prolateral leg II, large, black on retrolateral leg II, prolateral and retrolateral leg III and prolateral leg IV (Bertani & Huff, 2013). Males differ from all other congeners in the presence of well-developed keels on embolus of palpal bulb.



Figures 2-6. *Avicularia rickwesti* Bertani & Huff, 2013, male (NMPC P6A 6062) from Dominican Republic, Pedernales province, Oviedo, Los Tres Charcos. **2.** Carapace, dorsal view. **3.** Sternum, labium, maxillae and coxae, ventral view. **4.** Ocular tubercle, dorsal view. **5.** Cymbium with bulb of left palp, ventral view. Arrow shows small conical process covered with granules between cymbial lobes. **6.** Right tibia I with single subapical tibial apophysis, apically densely covered with numerous short spines, ventral view. Scale bar = 1 mm (Figures 4, 5, 6). Scale bar = 10 mm (Figures 2, 3).

Table I. *Avicularia rickwesti* Bertani & Huff, 2013, male (NMPC P6A 6062). Lengths of palpal and leg segments:

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Palp	5.50	3.36	4.38	-	2.55	15.79
Leg I	8.90	5.09	6.72	7.13	5.19	33.09
Leg II	8.45	4.78	6.62	6.62	5.09	31.56
Leg III	7.43	4.07	5.70	5.90	4.58	27.68
Leg IV	9.16	4.58	7.84	7.33	4.68	33.59



Figures 7-10. *Avicularia rickwesti* Bertani & Huff, 2013, male (NMPC P6A 6062) from Dominican Republic, Pedernales province, Oviedo, Los Tres Charcos. Morphology of right male palpal bulb. **7.** prolateral view. **8.** retrolateral view. **9.** dorsal view. **10.** ventral view. PS = prolateral superior keel, PI = prolateral inferior keel, A = apical keel. Scale bar = 1 mm.

DISTRIBUTION (Figure 1): Known only from Pedernales and Independencia provinces in Dominican Republic, Hispaniola.

MALE (NMPC P6A 6062): Total length: 19.3, carapace length 9.5, width 8.3 (Figures 2), chelicerae with 9-10 teeth on promargin, with granulation (microspikes) near last three basal teeth. Cheliceral teeth pattern from the basal end: right side: V-v-V-v-V-V-VVV, 7 big and 2 small teeth. Left side: V-v-V-v-V-V-VVVv, 7 big and 3 small teeth. Anterior eye row procurved, posterior eye row slightly recurved. Eye sizes and interdistances (Figure 4): AME 0.52 (circular), ALE 0.52 (oval), PME 0.26, PLE 0.49 (oval), AME-AME 0.39, AME-ALE 0.30, PME-PME 1.29, PME-PLE 0.05, ALE-PLE 0.21, AME-PME 0.10, OQ length 1.08, width 2.31. Ocular tubercle flattened, length 1.48, width 2.31, clypeus absent. Fovea transverse, width 1.42, 6.21 from the anterior edge of carapace. Labium length 1.17, width 1.52, anterior half with 71 cuspules, maxilla with 110-113 cuspules in basal half. Sternum length 5.08, width 3.76 (Figure 3), three pairs of oval marginal sternal sigilla located near coxae III (length 0.364, 0.260 from the edge), coxae II (length 0.338, 0.130 from the edge) and near coxae I (length 0.091, 0.136 from the edge). Leg pattern: IV>I>II>III. Incrassate leg segments absent.

Scopulae: All tarsi 100% scopulate, metatarsi I-III 95%, metatarsi IV 60% scopulate. Tarsi I-III with scopula entire, tarsi IV partly divided and metatarsi IV divided by a band of setae. Scopulae on tarsi and metatarsi I and II laterally extended, distinctly less developed in posterior tarsi and metatarsi. Claw tufts paired, well-developed. Dorsal face of all tarsi with two irregular longitudinal rows of short claviform trichobothria, present in apical half only, both rows are diverging towards the basal half of this leg segment. Cymbium with two such rows of short claviform trichobothria, arranged in V-shape and present in apical two thirds. All paired tarsal claws without teeth. Plumose setae on retrolateral face of femur IV absent.

Spination: absent on all leg segments and palps.

Palpal organ (Figures 7-10), with embolus short and stout, spoon-like shaped, carrying three well-developed smooth keels, PS, PI and A keel. Tegulum oval, smooth, without any tegular structures. Cymbium with almost equal cymbial lobes and small conical process (diameter 0.494) covered with granules between them (Figure 5). Palpal tibia without any process. Tibia I with single subapical tibial apophysis, apically covered with numerous short spines (Figure 6). Metatarsus I contacts the retrolateral side of tibial apophysis when flexed. Maxillary and trochanteral stridulatory bristles absent. Coxae III and IV prolaterally with a group of spiniform setae above suture. Abdomen: length 9.9, width 6.5, with type II urticating setae (Figure 12) and setae of intermediate morphology (Figure 13) between the type II and body setae (Figures 14-16), located in dorsoposterior part. PLS triarticulated, length 3.71, basal segment 1.22, middle segment 0.71, apical segment 1.78, all digitiform. PMS monoarticulated, length 0.94.

Coloration: dorsal view (Figure 11): carapace black covered with abundant pinkish setae, chelicerae black with pinkish setae. Coxae, trochanters, femora, patellae black with abundant pinkish setae, tibiae, metatarsi and tarsi greyish, with pinkish setae of distinctly lower density than in proximal articles. White rings on distal femora, tibiae and metatarsi present. Abdomen black with a light pattern, composing of a single, anteriorly located circular spot and two indistinct lateral stripes in central part of abdomen. Patellae I-IV and palpal patellae dorsally with two unequal, slightly diagonal stripes without covering pubescens, tibiae I-IV dorsally with two such longitudinal stripes. Ventral view: labium, sternum, maxillae, coxae, legs and abdomen dark.



Figure 11. *Avicularia rickwesti* Bertani & Huff, 2013, male from Dominican Republic, Pedernales province, Oviedo, Los Tres Charcos. Habitus, dorsal view. Right leg III is missing.

OTHER MATERIAL EXAMINED: *Avicularia rickwesti* Bertani & Huff, 2013, female (RKCP 0583), male (NMPC P6A 6062) from Dominican Republic, Pedernales province, Oviedo, Los Tres Charcos, 17°49'10.3"N 71°26'15.1"W, 71 m a.s.l., 12.III.2014, F. Kovařík, R. Teruel & P. Kindl col. (found in dry semicaducifolious forest growing on karstic soil).

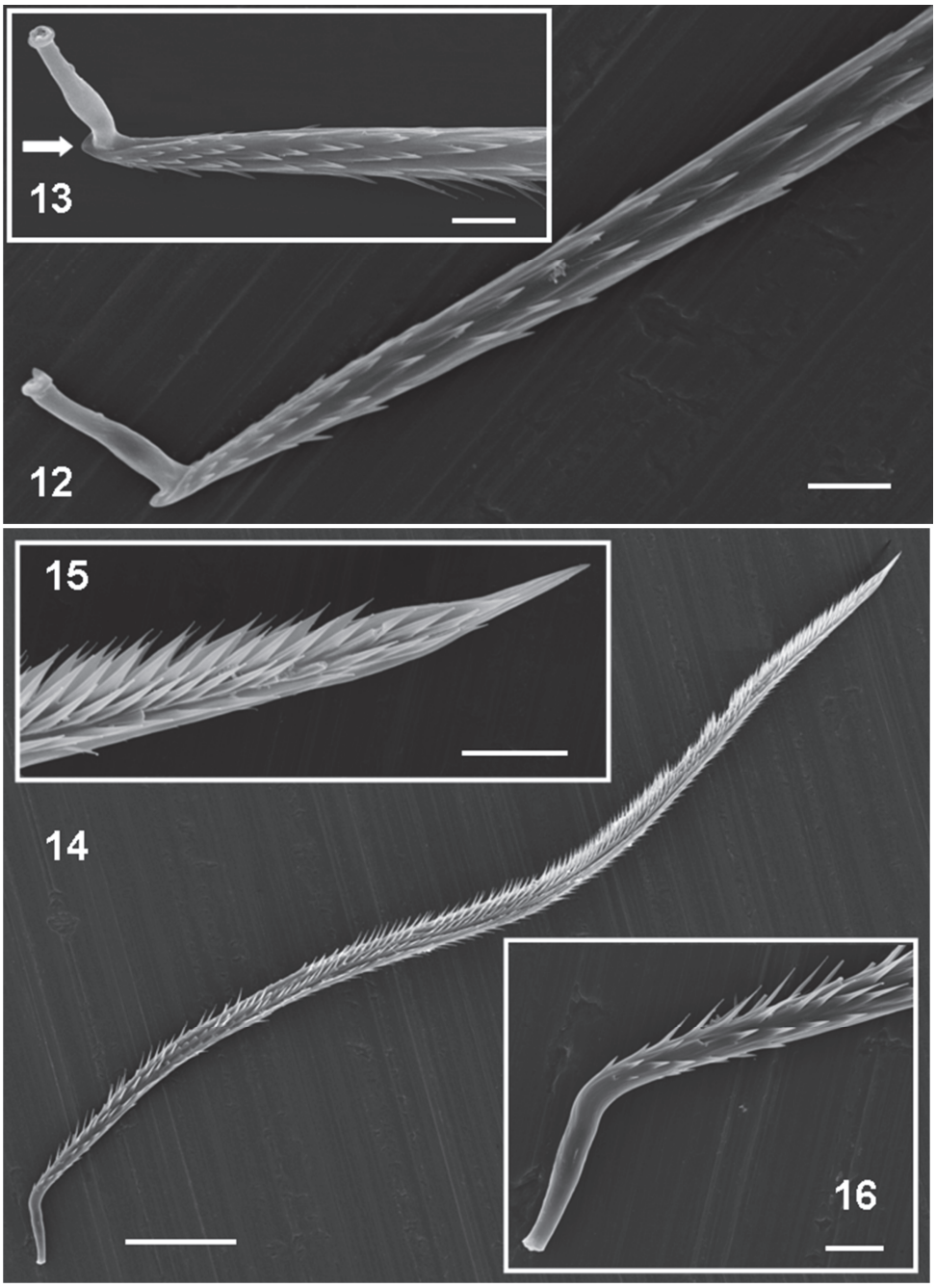
Discussion

The presence of keels in male palpal bulb morphology is considered a synapomorphy for the subfamily Theraphosinae (Theraphosidae), together with the presence of urticating setae of types I and/or III and/or IV and extended subtegulum (Pérez-Miles *et al*., 1996). Bertani (2000) homologized male palpal bulb structures of theraphosine spiders and proposed a new terminology for keels and related structures. The keels on emboli occur in representatives of other subfamilies as well, e.g. in Schismatothelinae Guadanucci, 2014 (*Euthycaelus colonicus* Simon, 1889; *Schismatothele* Karsch, 1879), Stromatopelminae Schmidt, 1993 (*Encyocratella olivacea* Strand, 1907) or Selenocosmiinae Simon, 1889 (*Poecilotheria* Simon, 1885; *Chilobrachys* Karsch, 1891; *Haplocosmia* Schmidt & Von Wirth, 1996; *Phlogiellus* Pocock, 1897; *Orphnaecus* Simon, 1892). As the terminology of keels was not established for these taxa, some authors (e.g. West, Nunn & Hogg, 2012) use for description of these structures the terminology proposed by Bertani (2000) for theraphosine spiders.

The presence of keels was newly recorded also in Aviculariinae, in males of *Avicularia rickwesti*. The shape of embolus and the arrangement and mutual position of keels are congruent to those found in *Brachypelma* Simon, 1891 (Theraphosinae) and for that reasons they were described here by the same way. However, their homoplasy with keels found in Theraphosinae is proposed, supported by the results of phylogenetic analyses made by West *et al*. (2008), Bertani (2012), Guadanucci (2014), considering the subfamilies Theraphosinae and Aviculariinae as non-sister groups.

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Figures 12-16. *Avicularia rickwesti*, female (RKCP 0583) from Dominican Republic, Pedernales province, Oviedo, Los Tres Charcos. **12.** Type II urticating seta, basal section with supporting stalk. Apical section is bare. **13.** Seta of intermediate morphology between body setae and type II urticating setae, basal section with a supporting stalk. Arrow shows a precursor of basal tip. **14.** Body seta. **15.** Detail of apical section. **16.** Detail of basal section with a supporting stalk. Scale bar = 0.05 mm (Figure 14). Scale bar = 0.01 mm (Figures 12, 13, 15, 16). Photos by Jana Bulantová.

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