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## Two new species of *Pulvillophylus* from Western Australia (Insecta: Hemiptera: Miridae: Phylinae: Cremnorrhinini)

MICHAEL D. SCHWARTZ<sup>1</sup> AND RANDALL T. SCHUH<sup>1</sup>

### ABSTRACT

Two new species of phylina Miridae were collected from unique localities in Kadji Kadji and Lochada Reserves of Western Australia during the Avon Wheatbelt Bush Blitz survey of September 2009. Based on head shape and male genitalic structure, *P. cuneomaculatus*, n. sp., and *P. ecdeiocoleae*, n. sp., are members of *Pulvillophylus* Schuh and Schwartz, 2016. The latter species was taken on the flower spikes of *Ecdeiocolea monostachya* F. Muell. (Ecdeiocoleaceae) and provides the first confirmed host-plant record for the genus *Pulvillophylus*. Documentation for both species is provided by diagnoses, descriptions, color habitus images of males, a distributional map, illustrations of male genitalic structures, and images of the endosoma. Digital images of the dorsal habitus and female genitalic structures of *P. ecdeiocoleae* are provided as well as digital images and a distribution map for the plant host.

### INTRODUCTION

Schuh and Schwartz (2016) recently described 19 new genera and 82 new species of Cremnorrhinina from Australia, recording the taxon for the first time from the continent. In the present paper we describe two additional new species, placing them in the genus *Pulvillophylus* Schuh and Schwartz. Of the genera described by Schuh and Schwartz (2016), *Pulvillophylus*

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was the least well understood in terms of host associations, with none of the five described species having a verified host. *Pulvillophylus ecdeiocolae*, recorded as feeding on the monocot family Ecdeiocolaeaceae, offers a glimpse into potential host associations for the entire genus. Even though the male and female genitalia of the two new species show only very modest differences from the morphology seen in the five previously known species, the head shape and coloration extend the range of known variation in color and structure in the genus.

#### MATERIALS AND METHODS

Preparation of the genitalic structures, their terminology, and documented orientation follow that of Schuh and Schwartz (2016). The dorsal habitus photographs were produced with a Leica Z16APO macroscope, DFC425C digital scanning camera, and Zerene Stacker (ver. build T201510021255). Photographic images of the genitalic structures were taken with a 20× objective lens using a Nikon E800 compound microscope, Jenoptik ProgRes C14+ digital scanning camera, and Syncrosopy Auto-MontageH software. Measurements were prepared using an ocular micrometer. These data are presented in table 1 to simplify comparison among *Pulvillophylus* species. All the specimens for the two species described herein were collected during the 2009 Avon Wheatland Bush Blitz survey that sampled an area of endemism in nonmonsoonal semiarid Australia (Cassis and Symonds 2014).

Because of the limited number and poor condition of some of the specimens on hand, only measurements, in millimeters, of the holotypes and one female paratype are reported.

The distribution map for *Ecdeiocola monostachya* was created using the Atlas of Living Australia spatial portal on the Australia's virtual herbarium (Australia's Virtual Herbarium [AVH] 2015) website (<http://http://avh.chah.org.au/>) and SimpleMappr (Shorthouse 2010); habitus images of the host plant were acquired with permission from Briggs and Tinker (2014) (fig. 3C–G) and Loy (2015) (fig. 3B).

Specimen data were captured in the American Museum of Natural History (AMNH) instance of the Arthropod Easy Capture database <https://research.amnh.org/pbi/locality/>. A unique specimen identifier in the form of AMNH\_PBI 00000000 and a corresponding matrix code was attached to each specimen.

Specimen depository information, responsible individuals, and institutional abbreviations are as follows:

AMNH	American Museum of Natural History; Randall T. Schuh
UNSW	University of New South Wales; Gerasimos Cassis
WAMP	Western Australian Museum, Perth; Nikolai Tatarnic

Abbreviations for female genitalic structures in figure 1H–L are as follows: **acgl**, accessory (vermiform) gland; **bsfg**, basal sclerite of first gonapophyses; **dlp**, dorsal labiate plate; **isstr**, intersegmental structure; **latscl**, lateral interramal sclerite; **lsclr**, left sclerotized ring; **mdext**, medioventral extension of ventral labiate plate; **mdscl**, medial interramal sclerite; **rsclr**, right sclerotized ring; **smrcpt**, seminal receptacle; **vlp**, ventral labiate plate.

## TAXONOMY

*Pulvillophylus* Schuh and Schwartz, 2016: 173 (n. gen.).

DISCUSSION: Schuh and Schwartz (2016) discussed a single female of an undescribed species of *Pulvillophylus* as occurring on the genus *Calytrix* in the large myrtaceous tribe Chae-melauciae DC. They ventured that this undescribed taxon might offer insight into the hosts of other species. The recording of *Pulvillophylus ecdeiocolaeae* from the monocot family Ecdeiocolaeaceae (Poales) suggests a radically different conclusion: that some or all members of *Pulvillophylus* are actually monocot feeders and that their shape and coloration help to conceal them on their hosts. As noted by Schuh and Schwartz (2016), most members of the Cremnorrhiniina from outside Australia have an elongate head and projecting clypeus. Within the Australian fauna, most cremnorrhiniines are green or pale, with the obvious exception of most *Pulvillophyllus* species and some species of *Halophyllus* Schuh and Schwartz, 2016. There are only a few *Pulvillophylus* species, including the two described in this paper, that have a long face and also offer a color resemblance to the seeds of some monocots, including members of the Ecdeiocolaeaceae, Poaceae, and Restionaceae.

The Ecdeiocolaeaceae, previously contained in the Restionaceae (Culter and Airy Shaw, 1965), is considered the sister taxon of the Poaceae (Givnish et al., 2010; Briggs and Tinker, 2014). The species of this drought-adapted family are endemic to a limited area of Western Australia (fig. 4A), wind pollinated and monoecious, with spikes containing separate zones of pistillate and staminate flowers developing in acropetal succession (Briggs and Tinker, 2014). Ecdeiocolaeaceae contains three species placed in two genera (*Ecdeiocolaea monostachya*, *E. rigens* B.G. Briggs, and *Georgeantha hexandra* B.G. Briggs and L.A.S. Johnson). Cassis and Gross (1995, 2002) do not list any Heteroptera species associated with Ecdeiocolaeaceae. Only the ghost moth, *Fraus simulans* Walker, 1856 (Hepialidae), also found in several other Australian states, was reported to utilize *E. monostachya* (Main, 2001) as well as species of Poaceae (Hardy, 1973).

In the southern hemisphere the flora of East Africa is dominated by grasses and a large number of heteropterans are documented as feeding on the group, including within the Miridae (*Collaria* Provancher, 1872, *Dolichomiris* Reuter, 1882, *Nabidomiris* Poppius, 1914, and *Stenotus* Jakovlev, 1877). The monocot family Restionaceae is also diverse in southern Africa and has been documented as the host of several species in the family Blissidae (Slater, 1976, 1979) as well as the Miridae genus *Zalmunna* Distant, 1909 (R.T.S., personal obs.). Grasses also form a significant landscape element in Australia, but relatively very few species of Miridae have been documented as feeding on them (Cassis and Gross, 1995; Namayatova et al., 2013), but see Slater (1979) for information on the Blissidae and Cassis and Gross (2002) for treatments of other Australian pentatomorphan grass feeders. The Restionaceae are diverse in southwestern Australia, although they do not form such a conspicuous part of the landscape as they often do in the Cape region of South Africa. Leon and Weirauch (2015) described four species in the genus *Restiophyllus* Leon and Weirauch, placing them in the phyline tribe Semiini,

subtribe Semiina. The recorded hosts of the species are in the Restionaceae genera *Hypolaena* (*H. exsulca* R. Br., *H. humilis* (Gilg) B.G. Briggs and L.A.S. Johnson) and *Leptocarpus* (*L. scariosus* R. Br. and *L. tenax* (Labill.) R. Br.) and the Anarthriaceae genus *Lyginia* (*L. barbata* R. Br. and *L. imberbis* R. Br.) from southwestern Australia. These bugs have predominantly reddish coloration reminiscent of their restionaceous hosts and an elongate face, similar to that seen in some species of *Pulvillophylus*, although the male genitalia and pretarsus are distinct in the two groups. In the discussion of *P. augustus* Schuh and Schwartz, 2016, reference was made to a series of specimens from Hat Head National Park, New South Wales, taken on *Leptospermum* (Myrtaceae) with unknown generic placement. Schuh and Schwartz (2016: 176) suggested that these specimens were not members of the Cremnorrhinina; upon further examination of the genitalia we can now conclude that they represent a new species of *Restiophylus* and that perhaps the host association for these specimens is in error.

On the basis of these observations we posit that when the hosts of other members of *Pulvillophylus* are clarified most or all will be monocot feeders. We encourage future collectors to sample the Australian monocot fauna and document hosts in a more consistent fashion, as a way of testing this theory. To date, most specimens of the known taxa have been secured by general collectors, some at lights, but most probably through the use of sweep nets, the former method never providing host data and the latter usually applied without regard to better understanding the biology of the taxa being sampled.

### *Pulvillophylus cuneomaculatus*, new species

Figures 1A–C, 2, 3, table 1

**DIAGNOSIS:** Recognized by the large size, somewhat projecting face, mostly uniform dark gray coloration, base of cuneus conspicuously yellowish white with narrow reddish brown adjoining margin; dorsum with mixture of obvious black and wooly sericeous setae (fig. 1A); endosoma sigmoid, ventral strap forming a relatively stout, strongly curving, hooked apical spine (figs. 1B, C, 2). Most similar in size and form of head to *P. rubritinctus* Schuh and Schwartz, 2016; distinguished by clavus and corium strongly reddish in that species, rather than dark gray in *P. cuneomaculatus*, as well as subtle differences in length of ventral strap distad to secondary gonopore and form of hook on apical endosomal spine. Endosomal structure similar to *P. cuneotinctus* (Schuh and Schwartz, 2016) with ventral strap terminating in small hooked spine; distinguished by longer strap extending beyond secondary gonopore, smaller eye of male and overall gray coloration with contrasting base of cuneus in *P. cuneomaculatus*. Overall coloration of this taxon is reminiscent of the Palearctic phylina species *Europiella artemisiae* (Becker, 1864).

**DESCRIPTION:** *Male:* Total length 5.85, pronotum width 1.35. **COLORATION** (fig. 1A): Uniformly dark gray, including most of appendages; vertex with faint medial mark, posterior margin of eye narrowly pale; midline of corium posteriad of clavus and basad of membrane faintly pale; base of cuneus and corium, narrowly adjacent to cuneus, conspicuously yellowish white, cuneus posteriad of white area narrowly reddish brown; antennal segment 2, except apex, much paler than segment 1; membrane including veins strongly fumose; femora narrowly

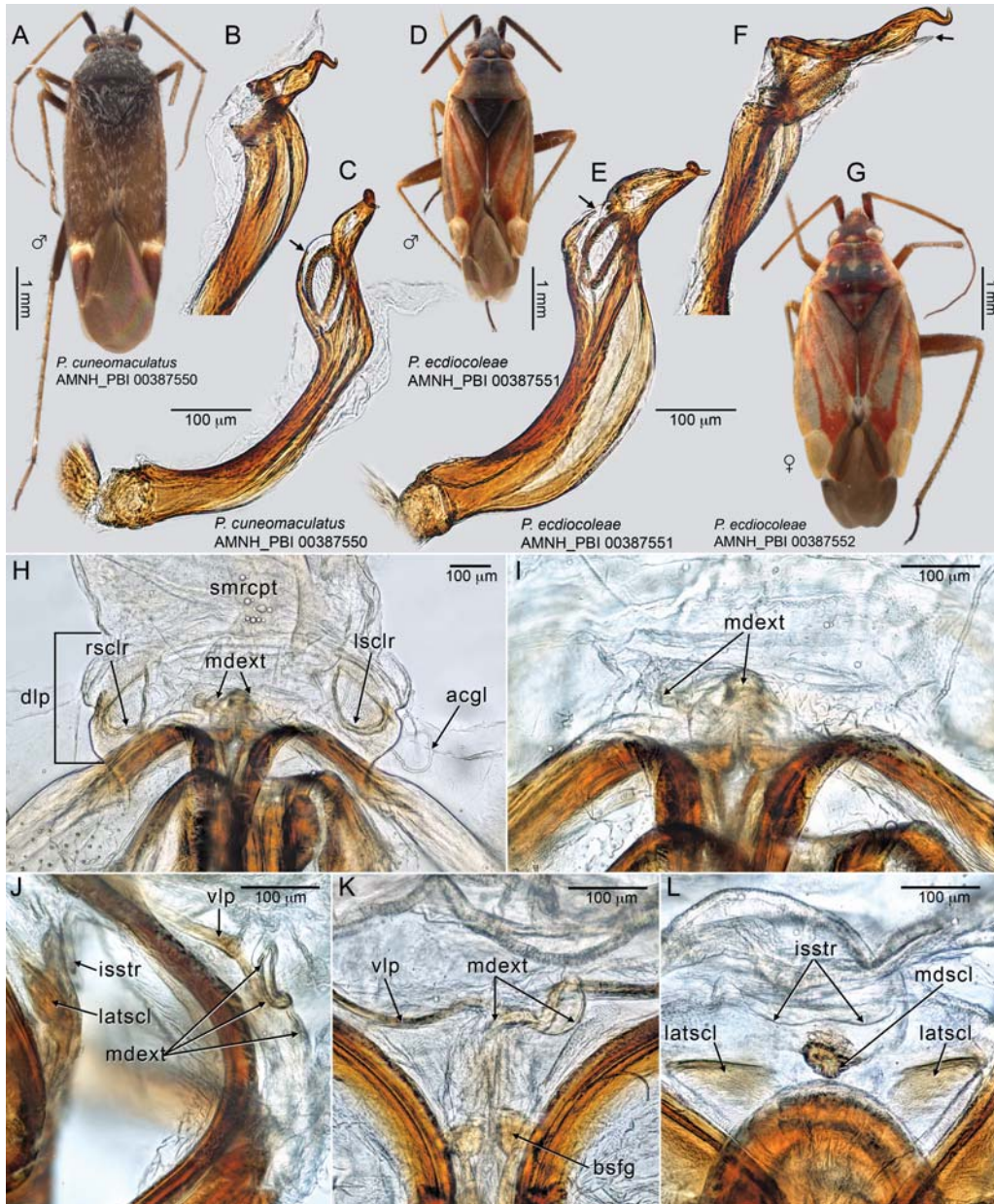


FIG. 1. *Pulvillophylus cuneomaculatus*. A. Habitus, male. B, C. Endosoma. B, Detail of distal region, dorsal view; arrow = accessory spine. C. Left lateral view; arrows = apex of dorsal straps. D–G, H–L. *P. ecleiocolaeae*. D. Habitus, male. E. Endosoma, left lateral view. F. Endosoma, detail of distal region, dorsal view; arrow = accessory spine. H. Bursa copulatrix, ventral view. I. Vestibular sclerites, ventral view. J. Bursa copulatrix, right lateral view. K. Vestibular sclerites, anteroventral view. L. Posterior wall, anteroventral view.

pale apically, tibiae paler than femora. SURFACE AND VESTITURE (fig. 1A): Body surface with reclining, black, common setae, pronotum with some erect spinelike setae on anterior lobe, and head, pronotum, scutellum, clavus, and anteriormost portion of corium also with scattered, weakly flattened, woolly, sericeous setae. STRUCTURE (fig. 1A): Body elongate, nearly parallel sided. **Head:** Moderately long, eyes slightly bulging; frons faintly swollen, barely prognathous, projecting beyond anterior margin of eye by length of eye, clypeus visible from above; eye occupying about four-fifths height of head in lateral view; antenna inserted at ventral margin of eye, eye not emarginate at insertion; labium reaching just beyond apex of metacoxa. *Antenna:* Segment 1 elongate, exceeding apex of head by one-half length of segment, segment 2 long (1.75), 1.78 times width of head. **Thorax:** Pronotum weakly campanulate, lateral margins weakly sinuous, posterior lobe and calli weakly elevated, posterior margin straight; mesoscutum broadly exposed. *Hemelytron:* Costal margin very weakly convex, body elongate nearly parallel sided. GENITALIA (figs. 1B, C, 2): **Pygophore:** Elongate conical, ventral surface with faint transverse serrations. **Endosoma:** Sigmoid; ventral strap relatively short, subequal to length of secondary gonopore, forming sharply hooked spine with minute subtending tubercle; dorsal strap terminating subequal to distal edge of secondary gonopore. **Phallosome:** Long, narrowly conical; aperture on anterior surface, long, with equal moderate width, attenuate distally; surface of basal portion strongly ribbed. **Parameres:** Left paramere with typical phyline structure. Right paramere of moderate size, broadly fusiform, with short terminal spine.

*Female:* Unknown.

ETYMOLOGY: From the Latin, *macula*, “spot,” and *cuneus*, in reference to the conspicuous white base of the cuneus.

HOST: Unknown.

DISTRIBUTION (fig. 3): Known from the type locality, Kadji Kadji, in Western Australia.

HOLOTYPE: **AUSTRALIA: Western Australia:** Kadji Kadji Reserve, CY2, 29.23147°S 116.47769°E, 266 m, 17 Sep 2009, C. Young, black light bucket trap, Bush Blitz WA Sep 09, 1 ♂ (AMNH\_PBI 00387550) (WAMP).

### *Pulvilophylus ecdeiocolae*, new species

Figures 1D–L, 2, 3, table 1

DIAGNOSIS: Recognized by the moderately large size, projecting face, pale brown general coloration with black head, antenna, calli, and scutellum, reddish brown pattern on hemelytron dorsum, male with fusiform antennal segment 2 (fig. 1D); endosoma sigmoid, apical region equal to length of secondary gonopore with simple hooked terminal spine (figs. 1E, F, 2). Most similar in size, form of head, and coloration, to *P. rubritinctus*; distinguished by slightly smaller size, distinct black coloration on head, pronotum, scutellum, and anterior region hemelytron, fusiform antennal segment 2, and endosoma with shorter ventral strap distad of secondary gonopore.

DESCRIPTION: *Male:* Mean total length 5.00, mean pronotum width 1.35. COLORATION (fig. 1D): Background coloration tan to pale brown; dark brown to black on antennal segments, head, except medially on vertex, calli, mesoscutum, scutellum, and costal vein; reddish brown

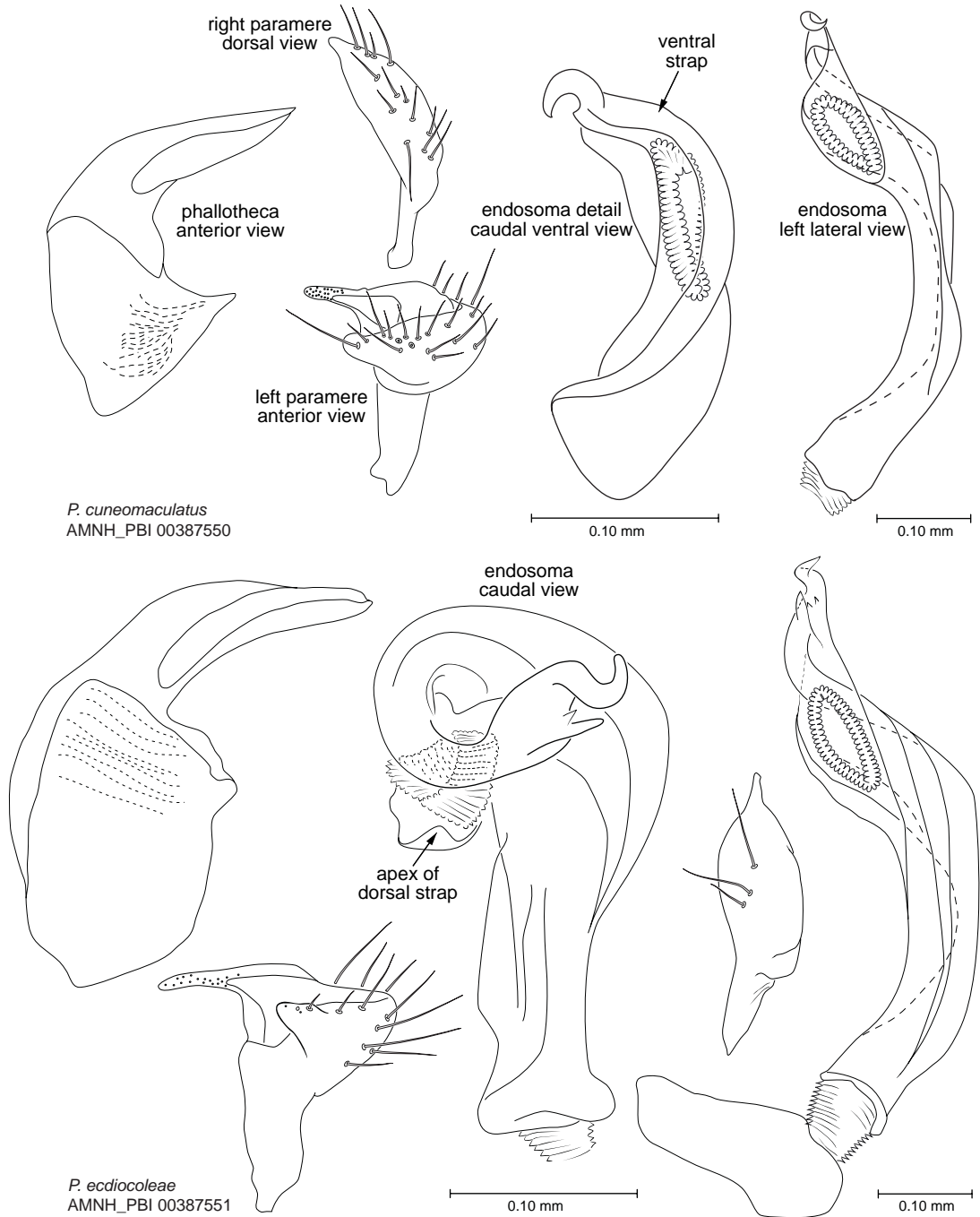


FIG. 2. Male genitalic structures of *Pulvillophylus cuneomaculatus* and *P. ecdeiocolaeae*.



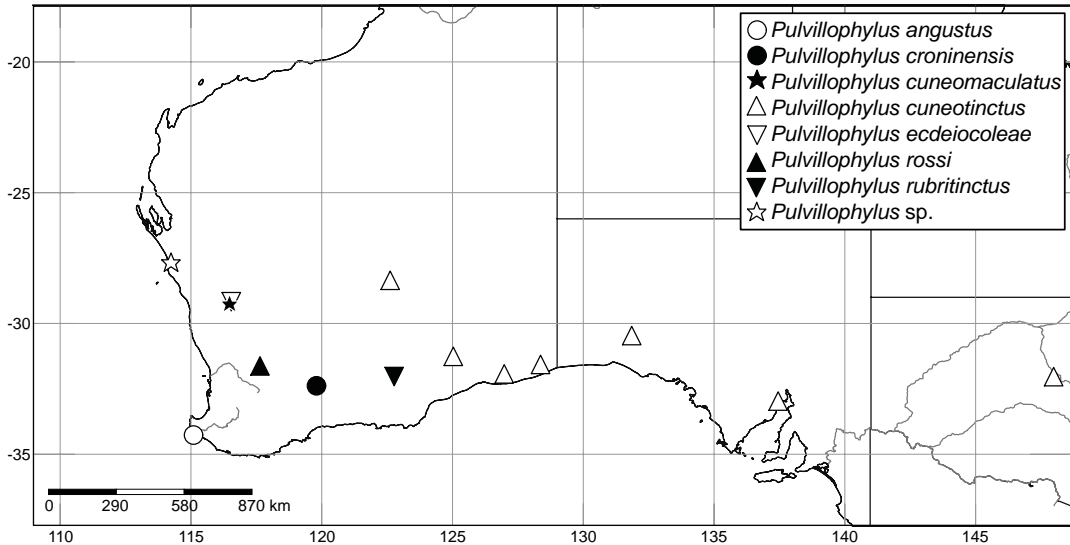


FIG. 3. Distribution of *Pulvillophylus* spp.

to red on pair of ray-shaped markings emanating posteriad of calli reaching posterior margin of pronotum, lateral spots on mesoscutum, clavus posteriorly, endocorium except medially, and medial strip on cuneus; membrane including veins fumose; hind femora dark reddish brown, remaining femora, tibiae, and tarsi paler reddish brown. **SURFACE AND VESTITURE** (fig. 1D): Body surface smooth, very weakly shining, with reclining, black, common setae, pronotum with some erect spinelike setae. **STRUCTURE** (fig. 1D): Body elongate ovoid. **Head:** Head prognathous, frons flattened, projecting beyond eye by about length of eye, clypeus projecting and visible in dorsal view; eyes large angulate along lateral margin of head in dorsal view; eye occupying 90% height of head in lateral view; antenna inserted just above ventral margin of eye; labium surpassing apex of metacoxa and reaching onto abdomen. **Antenna:** Segment 1 relatively short, exceeding apex of head by one-half length of segment, segment 2 fusiform, relatively short (1.43), 1.55 times width of head. **Thorax:** Pronotum weakly campanulate, lateral margin slightly concave, posterior lobe flattened, posterior margin excavated; mesoscutum broadly exposed. **Hemelytron:** Costal margin slightly convex. **GENITALIA** (figs. 1E, F, 2): **Pygophore:** Elongate somewhat parallel sided distally, ventral surface with prominent serration. **Endosoma:** Sigmoid; ventral strap moderately long, equal to length of secondary gonopore, forming sharply hooked spine with one accessory spine and two spicules basad of hooked apical spine; dorsal strap terminating equal to distal edge of secondary gonopore. **Phallosome:** Long, narrowly conical; aperture on anterior surface, long, with equal moderate width, attenuate distally; surface of basal portion strongly ribbed. **Parameres:** Left paramere with typical phylline structure. Right paramere of moderate size, fusiform, with abruptly narrow terminal spine.

TABLE 1. Measurements of *Pulvillophylus cuneomaculatus*, new species, and *Pulvillophylus ecdeiocolaeae*, new species

Species	Body	Length					Width				Ratio				
		Cun-Clyp	Head	Prono	Scut	Cun	Head	Prono	Scut	IntOcDi	AntSeg2	AS2/ HW	IOD/ HW	HW/ PW	PW/ BL
<i>P. cuneomaculatus</i>															
♂ (N = 1)	5.85	3.95	0.53	0.66	0.56	1.00	0.99	1.35	0.75	0.41	1.75	1.77	0.41	0.73	0.23
<i>P. ecdeiocolaeae</i>															
♂ (N = 1)	5.00	3.60	0.63	0.73	0.58	0.60	0.90	1.35	0.75	0.38	1.43	1.59	0.42	0.67	0.27
♀ (N = 1)	5.90	4.10	0.75	0.80	0.68	0.73	0.96	1.56	0.81	0.44	1.81	1.89	0.46	0.62	0.26

**Female:** (fig. 1G): Structure and coloration similar to male, except body more ovoid, antennal segment 2 narrower, slightly bowed; mean total length 5.90, mean pronotum width 1.56. **GENITALIA: Subgenital plate of sternite 6:** With posteriorly directed conical projection. **Vestibular sclerites:** Medium size, not attaining anterior edge of dorsal labiate plate (fig. 1H–J). **First gonapophyses:** Small basal blocks (fig. 1K). **Ventral labiate plate:** Platelike medial anteroventral extension absent (fig. 1K). **Dorsal labiate plate:** Medium size, short longitudinally (fig. 1H). **Sclerotized rings:** Moderately large, subovoid, anterior angle pointed, relatively flat, thin walled; dorsal labiate plate ventrad of rings finely spiculate (fig. 1H). **Posteromedial region:** Surface without conspicuous microstructure. **Anterolateral region:** Anterior margin extending slightly beyond anterior edge of sclerotized rings, narrow band spanning rings. **Posterior wall:** **Intersegmental structure:** Flat, broadly bilobed, platelike, apically rounded. **Interramal sclerites:** Strongly sclerotized, lateral sclerites widest mediad, narrowed laterally, medial sclerite bell shaped, produced posteriorly (fig. 1J, L).

**ETYMOLOGY:** Named for the association with a plant species in the genus *Ecdeiocola* F. Mull., which currently contains the only known host for any species of *Pulvillophylus*. A noun in genitive case.

**HOST:** All specimens were taken on the flowering spikes of *Ecdeiocola monostachya* (Ecdeiocolaeaceae) (C. Symonds, personal commun.) (fig. 4).

**DISTRIBUTION** (fig. 3): Known only from the type locality near Lochada, Western Australia.

**HOLOTYPE: AUSTRALIA: Western Australia:** Lochada, Omega track 1.5 km N of Mungada Rd, 29.16827°S 116.54336°E, 281 m, 18 Sep 2009, C. Symonds, Bush Blitz WA Sep 09, *Ecdeiocola monostachya* F. Muell. (Ecdeiocolaeaceae), det. WA Herbarium, 1♂ (AMNH\_PBI 00387551) (WAMP).

**PARATYPES: AUSTRALIA: Western Australia:** Lochada, Omega track 1.5 km N of Mungada Rd, 29.16827°S 116.54336°E, 281 m, 18 Sep 2009, C. Symonds, *Ecdeiocola monostachya* F. Muell. (Ecdeiocolaeaceae), det. WA Herbarium, 1♀ (AMNH\_PBI 00387556) (AMNH), 1♂ (AMNH\_PBI 00387554), 4♀ (AMNH\_PBI 00387552, AMNH\_PBI 00387555, AMNH\_PBI 00387557, AMNH\_PBI 00387558) (UNSW), 3♀ (AMNH\_PBI 00387559-AMNH\_PBI 00387561) (WAMP).

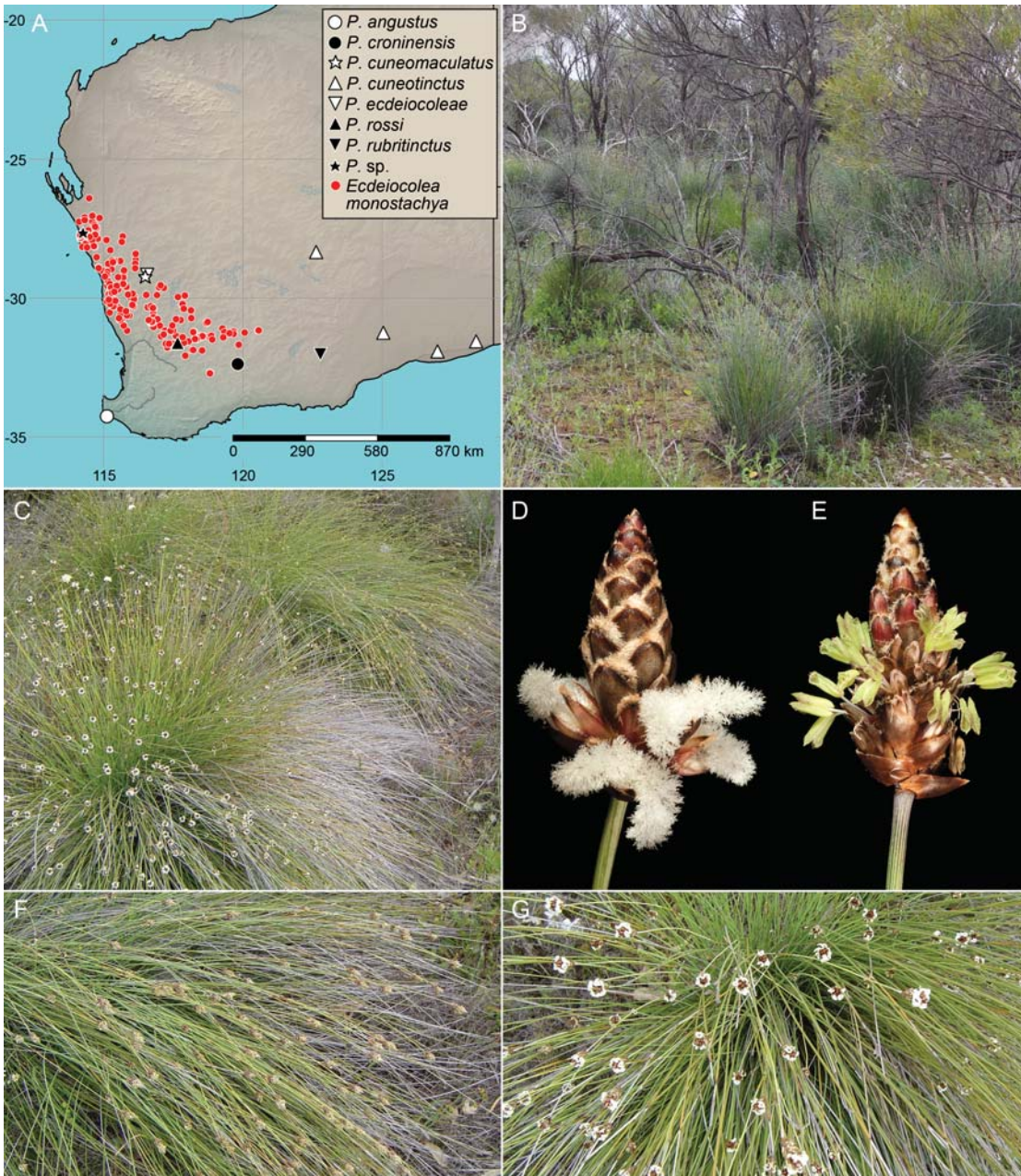


FIG. 4. *Ecdeiocolea monostachya*. A. Distribution. B. Plant on sandy soil in open scrubland at Xantippe, Western Australia. C. Adjacent plants in pistillate (lower left) and staminate (in background) flowering stages, Arrowsmith River, near Eneabba. D. Spike with lower pistillate flowers with exerted stigmas. E. Spike with exerted, dehisced anthers of lower staminate flowers; the lower pistillate flowers showing fruit development. F. Plant in female stage. G. Plant in male stage. (Photo credits: C, F, G, B.G. Briggs; B, X. Loy; D, E, K.R. Thiele).

OTHER SPECIMENS EXAMINED: **AUSTRALIA: Western Australia:** Lochada, Omega track 1.5 km N of Mungada Rd, 29.16827°S 116.54336°E, 281 m, 18 Sep 2009, C. Symonds, Bush Blitz WA Sep 09, *Ecdeiocolea monostachya* F. Muell. (Ecdeiocolaeaceae), det. WA Herbarium, 1 nymph; (AMNH\_PBI 00387562) (UNSW).

DISCUSSION: If our prediction that *Pulvillophylus* species for which hosts are currently unknown are also monocot feeders, then we would also predict that the eventual hosts are in families other than the Ecdeiocolaeaceae, because most of those species have been collected outside the known distributions of members of the Ecdeiocolaeaceae (Briggs and Tinker, 2014). Only *P. cuneomaculatus*, n. sp., *P. rossi* Schuh and Schwartz, 2016, and an unnamed species, known from one female, appear to have been collected within the range of ecdeiocolaeaceous species (see fig. 4A; collection records of the other two species of Ecdeiocolaeaceae are subsumed within the range of *E. monostachya*).

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