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A review of *Fedrizzia* mite species (Acari: Mesostigmata: Fedrizziidae) found in association with Australian *Mastachilus* beetles (Coleoptera: Passalidae)

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ABSTRACT

Mites of the genus *Fedrizzia* from passalid beetles of the genus *Mastachilus* are reviewed, and two new species, *Fedrizzia classeni* sp. nov. and *Fedrizzia humei* sp. nov. are described, both associated with *Mastachilus polyphyllus* (Macleay, 1826). *Fedrizzia oudemansi* Womersley, 1959, is redescribed and shown to occur only on the southern form of *Mastachilus australasicus* (Percheron, 1841); previous records of this mite from *M. polyphyllus* are placed in *F. classeni*. A revised key to *Fedrizzia* is presented. ❑ *Trigynaspida, Antennophorina, host-associations, passalids, new species, key*.

Fedrizziid mites are large, glossy brown mites that live with passalid beetles, a sub-social group of insects that live in family groups in rotting logs. Immature fedrizziid mites dwell in the beetle's tunnels where they are predators, most likely on nematodes (Seeman 2000). Once becoming adults, they move on to their host beetle where they remain closely associated for the rest of their adult life. Although they attend to their host closely, feeding from the host has never been observed. Instead, they presumably are opportunistic predators and scavengers, leaving the beetle to feed in close proximity. In the laboratory, adults fed on nematodes and used their long filamentous cheliceral excrescences to mop-up the fluids from dead microarthropods (Seeman 2000). Females deposited eggs on the substrate in the laboratory, and probably do the same in the tunnels of passalid beetles.

The Fedrizziidae includes 34 species in three genera: *Fedrizzia* (11 species) *Neofedrizzia* (22 species), and *Parafedrizzia* (1 species) (Womersley 1959; Seeman 2007, 2009). Each passalid beetle species is host to one to seven species of fedrizziid mites, with smaller host species tending to have fewer mite species (Table 1). Mite species can also differ in geographical space. For example, *Pharochilus dilatatus* (Dalman, 1817) typically hosts the widespread species *Neofedrizzia camini* Womersley, 1959, but in the Bunya Mountains *P. dilatatus* is host to another species, *Neofedrizzia bunyas* Seeman, 2007, and *N. camini* is absent (Seeman 2007; Table 1). Consequently, the 34 species of Australian passalid beetles (Dibb 1938; Van Doesberg 1992) are likely to carry several times as many fedrizziid mite species. Add to this a multitude of other families of mites found on passalid beetles—12 in Australia, 25 worldwide—and it seems likely that Australian passalid beetles alone carry a startling number of undescribed species (Hunter 1993; Seeman 2001, 2002, 2007).

I here describe two new species of *Fedrizzia* from *Mastachilus polyphyllus* (Macleay, 1826), which hitherto had not been searched for fedrizziid mites. I also redescribe *Fedrizzia oudemansi* Womersley, 1959, which is found on the southern form of *Mastachilus australasicus* (Percheron, 1841).

MATERIALS AND METHODS

Mites were collected from the bottom of tubes containing beetles killed in 80% ethanol, or removed from pinned specimens. The mites

Table 1. Fedrizziid mites associated with Australian passalid beetles. Incidental records of mites that typically have other host beetles are not included (see Seeman 2007); passalid species that cannot be verified as hosts are not included. Host sizes from Dibb (1938) and specimens in the Queensland Museum.

Passalidae beetle species	Host size (mm)	Fedrizziidae mite species
Subfamily Passalinae		
Analaches australiensis [2]	26–30	*Fedrizzia bornemisszai*
Austropassalus hultgreni	26–30	*Neofedrizzia lepas*
Gonatus sp. [2]	20–33	*Fedrizzia bornemisszai*
Mastachilus australasicus (southern form)	38–42	*Fedrizzia abradoalves* *Fedrizzia oudemansi* *Fedrizzia parvipilus* *Fedrizzia sellnicki* *Neofedrizzia camini* *Neofedrizzia tragardhi* *Neofedrizzia vidua*
Mastachilus australasicus (northern form)	44–51	*Neofedrizzia brooksi* *Neofedrizzia helenae* *Neofedrizzia imparmentum*
Mastachilus polyphyllus	35–40	*Fedrizzia classeni* *Fedrizzia humei*
Mastachilus quaestionis	45–53	*Fedrizzia parvipilus* *Fedrizzia sellnicki* *Neofedrizzia bunyas* [1] *Neofedrizzia camini* *Neofedrizzia vidua*
Pharochilus dilatatus	28–32	*Fedrizzia abradoalves* *Neofedrizzia camini* *Neofedrizzia cynota* [2] *Neofedrizzia gorirossiae* [2] *Neofedrizzia tragardhi*
Pharochilus scutellonotus	36–39	*Neofedrizzia camini* *Neofedrizzia tragardhi*
Subfamily Aulacocyclinae		
Aulacocyclus edentulus	23–30	*Neofedrizzia canestrinii*
Aulacocyclus fracticornis	22–28	*Neofedrizzia canestrinii*
Aulacocyclus kaupi	27–29	*Neofedrizzia canestrinii*
Aulacocyclus teres	35–40	*Neofedrizzia jeffi* *Neofedrizzia susanae*

[1] *Neofedrizzia bunyas* replaces *N. camini* in the Bunya Mountains, SE Qld. [2] Known from single record only.

were then cleared in Nesbitt's fluid, mounted in Hoyer's medium, dried, and ringed with insulating varnish. Host beetles were identified with Dibb (1938) and Seeman (2002). Measurements and illustrations were made with the aid of a Nikon Eclipse 80i microscope equipped with DIC and a drawing tube. Morphology and setal designations follow those used in Seeman (2007). Measurements are in micrometres, and lengths and widths were measured at the longest or widest point of the relevant structure. Collection abbreviations are used for

the Queensland Museum, Brisbane (QM), the Australian National Insect Collection, Canberra (ANIC), and the South Australian Museum, Adelaide (SAMA).

SYSTEMATICS

Fedrizzia Canestrini, 1884

Fedrizzia Canestrini, 1884: 707; Seeman (2007: 15) [modern diagnosis]. Type species: *Fedrizzia grossipes* Canestrini, 1884, by monotypy.

Toxopeusia Oudemans, 1927: 80. Type species not designated. Synonymy by Womersley (1959).

Fedrizzia classeni sp. nov.

(Figs 1–3)

Fedrizzia oudemansi — Seeman, 2007: 27 [only specimens from Rockwood].

Material examined. HOLOTYPE: QM-S95263, ♀, Barakula State Forest, southeast Queensland, 26°26′S 150°30′E, 10–16.x.2004, C. Burwell, Cypress forest (sampcode 52067), ex *Mastachilus polyphyllus* (Passalidae). PARATYPES: QM-S95264–6, ♀, 2 ♂♂, same data as holotype; QM-S74031–35, 3 ♀♀, 2 ♂♂, Rockwood, via Chinchilla, 1987, W. McKenzie, on passalid beetle; ANIC-51-006248, ♀, data as for holotype; ANIC-51-006249, ♂, data as for holotype.

Diagnosis. Both sexes: idiosoma length 725–810; dorsal shield with 3–6 larger pores medially; ventral shield with lineate reticulation laterally, smooth medially; ventrianal shield lineate-reticulate laterally and posteriorly, smooth anteromedially; marginal shield weakly lineate-reticulate; anterolateral corner of ventrianal shield not fused with ventral shield; exopodal patterning between CxII–III spotted; pedofossae III absent; CxIV-marginal suture absent; femur III and IV with small lamellae, seta *pv1* not significantly thickened; femur IV not elongated, larger than femur III; seta *h1* smooth, slightly curved. Female: *st2* length 5–8, *st3–4* length 11–15, lyrifissure *stp2* posterior to *stpx*; sternogynal shield with weak honeycomb-like reticulation internally, flanked by four pairs of pores and one pair of setae. Male: sternoventral shield without suture posterior to genital opening; genital opening flanked by one pair of pores; seta *h1* curved, flattened slightly; seta *h3* positioned posteromedial to *h2*.

Description. Female (n = 6). *Idiosoma* (Fig. 1A) length 725–810, width 540–610 (holotype 785 x 570). *Dorsum.* Dorsal shield with anterior hyaline projection bearing one pair of barbed setae, length 61–63; hypertrichous, with *c.* 230–260 minute setae; with numerous (*c.* 80) smaller pores and 3–6 larger medial pores (subcuticular gland 6–10 diameter); with sublateral line of 36 pores; dorsal patterning comprises fine transverse to oblique lines and incomplete reticulation; marginal setae length 6. *Venter.* Tritosternum base length 26–27, width 34–39 (Fig. 1B). Presternal and sternal shield smooth; presternal shield rectangular, length 30–32 at midline, width 87–95; *st1* barbed, length 35–40; *st2* barbed, length *c.* 55; *st3* with few barbs, length 15, *st4* with 1–2 barbs, length 11–15; posterolateral margin of sternal shield pointed, *st3–4* 4–8 anterior to posterior margin, pore *stpx* anterior to *stp2*. Sternogynal shield length 118–125, width 140–156, with weak internal honeycomb-like reticulation, not surrounded by smooth area; shield flanked by four pairs of pores and one pair of setae. Ventral shield lineate laterally, smooth medially, a large pore medially between CxIII–IV, without pore posteromedial CxIV, two pairs of large pores, *c.* 7–8 pairs of small round pores, 10 pairs of setae, the most posterior and lateral length 8–12. Ventrianal shield length 165–175, width 435–465, fine lineate network of reticulation laterally and posteriorly, smooth anteromedially, two pairs of setae anterior to anus, three lateral pairs length 12–16, paranal setae length 32–34; anterolateral corner of ventrianal shield not fused with ventral shield. Marginal shields with lineate reticulation.

Legs. TrI with seta *pv1* with minute barbs, not thicker than seta *av1*. FeI with seta *pv3* similar to seta *pv1* and *pv2*. FeII with lamella distal to seta *pv1*, seta *ad1* smooth, thickened. FeIII with small lamella, seta *pv1* not spine-like. FeIV similar to FeIII, not elongated, length 95–100, width 74–80 at distal end, with small lamella, seta *pv1* not spine-like, seta *pd2* just proximal to seta *ad2* (Fig. 2A). TaII with seta *av2* spine-like, subequal in length to *av3*; Ta III with seta *av2* thickened, subequal in length to seta *av3*. Legs II–IV with thin, setiform *ad* and *pd* setae.

Gnathosoma (Figs 2B–E). Seta *h1* smooth, slightly curved, length 43–47, distance between *h1–h1* 20–24; *h2* barbed length 28–36; *h3* length 6–8, posterolaterad *h2*; palpcoxal seta length 11–14. Corniculi on tubercles, tubercle length

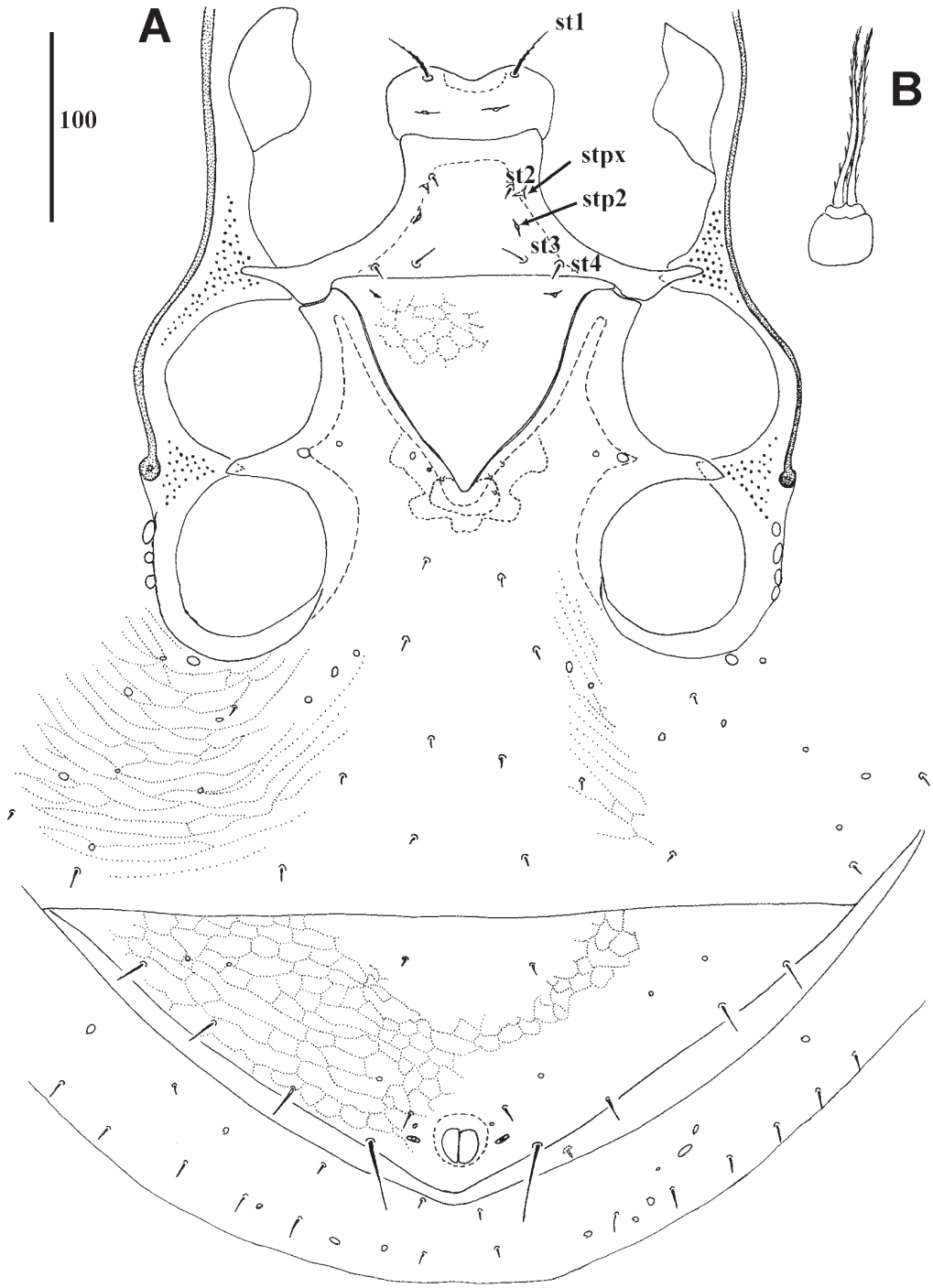

FIG. 1. *Fedrizzia classeni* sp. nov. Female: **A**, venter. **B**, tritosternum. Reticulation shown completely only on left-hand side of illustration.

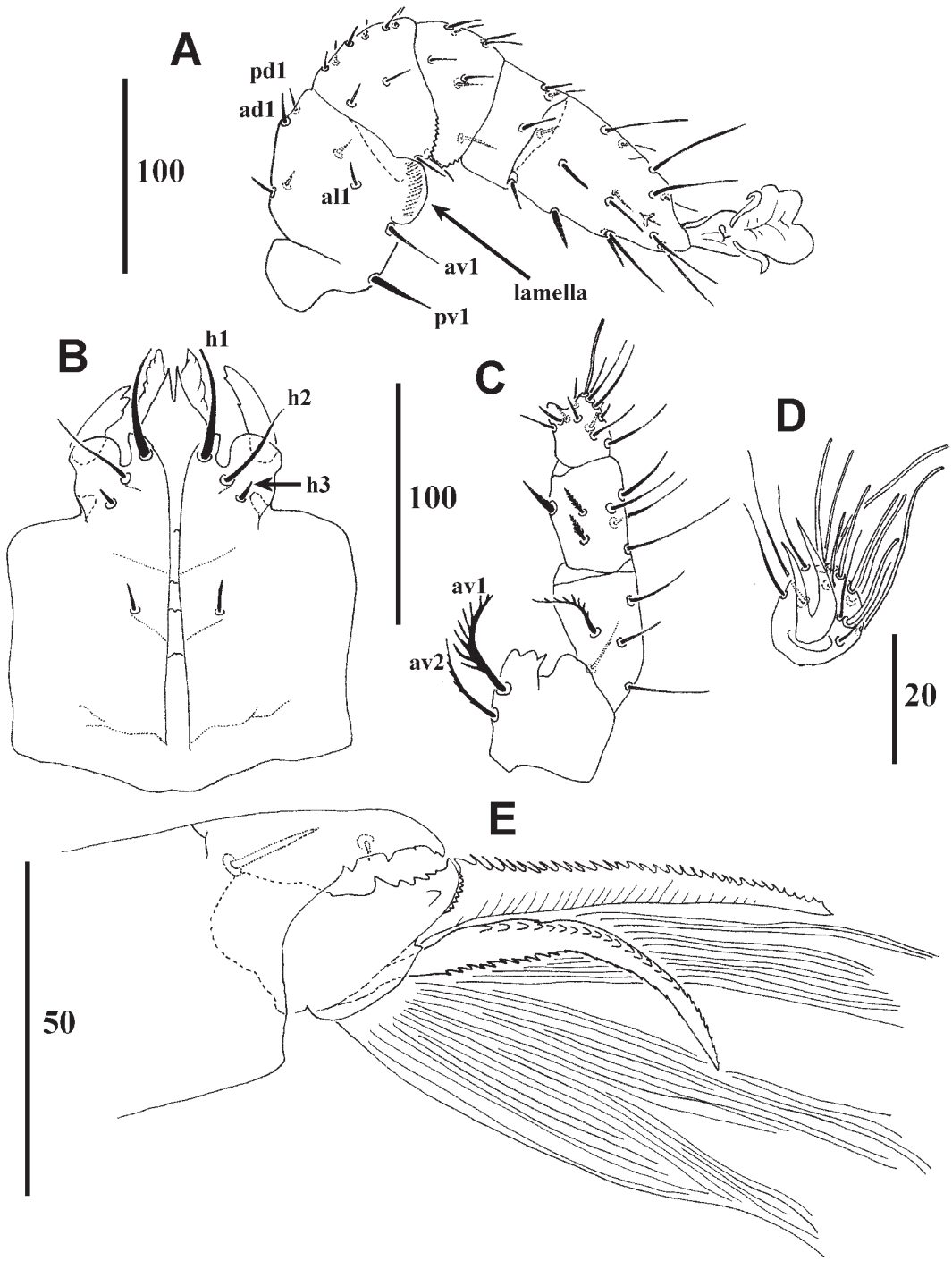

FIG. 2. *Fedrizzia classeni* sp. nov. Female: **A**, leg IV, right-hand side anterior view; femoral setae partially labelled, lamella indicated. **B**, hypostome. **C**, palp trochanter-tibia. **D**, palp tarsus. **E**, chelicera.

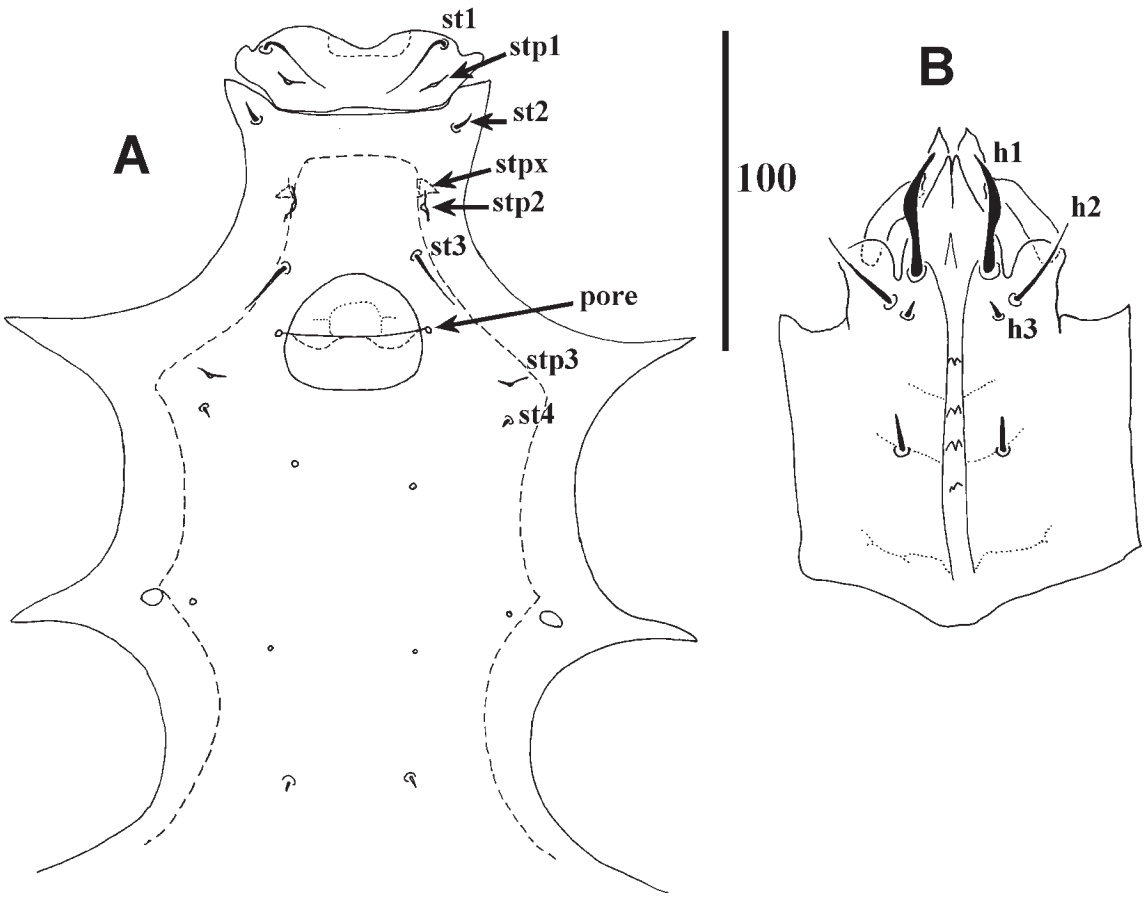

FIG. 3. *Fedrizzia classeni* sp. nov. Male: **A**, sternoventral shield. **B**, hypostome.

14; corniculi palmate, tip toothed. Palp, seta *av1* on trochanter with 8–9 branches, seta *av2* barbed, spur with one sharp and two blunt processes (Figs 2C–D). Chelicera, fixed digit length 140, movable digit length 42, fixed digit with two large and two minute teeth; excrescences arise from an enlarged base of digit and comprise a large brush-like process, a ribbon-like process with a serrate edge, and a ribbon-like process with a crenate and toothed edge; processes extend at least 55 past end of chelicerae (Fig. 2E).

Male (n = 5). *Idiosoma* length 700–770, width 505–545. Presternal shield length 20–23 at midline, width 78–90; *st1* barbed, length 27–30; *st2* smooth, length 5; *st3* smooth, length 10–12. Genital opening length 39–41, width 48–50. Suture posterior to genital opening absent (Fig. 3A). *Gnathosoma.* Seta *h3* length 6, just anterior to *h2* and closer to midline than *h2*. Seta *h1* broadened, curved, length 38–42 (Fig. 3B).

Etymology. This species is named for Adolph Classen, who was second-in-charge during Leichhardt's final expedition, but may have survived and lived out his life with the aboriginal people of central Australia.

Remarks. *Fedrizzia classeni* sp. nov. resembles *F. oudemansi* in its size, setae and shield ornamentation. However, it bears a small lamella on femur III and IV, a characteristic found only, amongst *Fedrizzia*, in *Fedrizzia gilloglyi* Seeman, 2007, from Thailand. *Fedrizzia gilloglyi* is much larger (length 1140–1160) than *F. classeni* sp. nov. (length 700–810) and lacks pores flanking the sternogynal shield (4 pairs in *F. classeni*).

Fedrizzia humei sp. nov.

(Figs 4–6)

Material examined. HOLOTYPE: QM-S95267, ♀, Barakula State Forest, southeast Queensland, 26°26'S 150°30'E, 10–16.x.2004, C. Burwell, Cyprus forest (sampcode 52067), ex *Mastachilus polyphyllus* (Passalidae). PARATYPES: QM-S95268–9, ♀, ♂, same data as holotype; ANIC-51-00625, ♂, same data as holotype.

Diagnosis. Both sexes: idiosoma length 860; dorsal shield with eight large pores; ventral shield with mesh-like pattern; marginal and ventrianal shields with mesh-like pattern; anterolateral corner of ventrianal shield fused with ventral shield; exopodal patterning between CxII–III spotted; pedofossae III absent; CxIV-marginal suture absent; femur III and IV without lamellae, seta *pv1* not significantly thickened; femur IV elongated; seta *h1* unmodified. Female: *st2* length 28, *st3* length 49–52, *st4* length 16; lyrifissure *stp2* anterior of *stpx*; sternogynal shield with honeycomb-like reticulation anteriorly, densely punctate posteriorly, flanked by 6–7 setae and 21 pores, surrounded by a smooth area extending 35 posterior of sternogynal shield. Male: sternoventral shield with suture posterior to genital opening demarking anterior smooth and posterior reticulated areas; genital opening not flanked by pores; seta *h3* positioned level with *h2*.

Description. Female (n = 2): *Idiosoma* (Fig. 4) length 860, width 675–680. *Dorsum.* Dorsal shield with anterior hyaline projection bearing one pair of barbed setae, length 56–61; hypertrichous, with *c.* 210–230 minute setae; with numerous (*c.* 220) smaller pores and 8 larger medial pores (subcuticular gland 10–15 diameter); with sublateral line of *c.* 100 pores; dorsal patterning comprises transverse to oblique lines and extensive punctations; marginal setae length 8–12. *Venter.* Tritosternal base length 35, width 45 (Fig. 4B). Presternal and sternal shield with fine mesh-like reticulation arranged in larger polygons; presternal shield rectangular, length 31–33 at midline, width 121–127; *st1* smooth, length *c.* 20; *st2* length 28, *st3* length 49–52, *st4* length 16, *st2–4* lightly barbed; posterolateral margin of sternal shield acutely pointed, *st3–4* 2–7 anterior to posterior margin, pore *stpx* posterior to *stp2*. Sternogynal shield length 100–103, width 160–166, with honeycomb-like reticulation anteriorly, otherwise densely punctate. Sternogynal shield surrounded by smooth area that extends 35 posterior of sternogynal shield; patch of smooth cuticle 40–45 diameter medially at posterior level of CxIV; remainder of ventral shield with mesh-like pattern. Sternogynal shield flanked by 6–7 setae (length 8–15) and 21 pores. Ventral shield with large pore (8 diameter) posteromedial of CxIV, four pairs of pores laterad CxIV, *c.* 16 pairs of small round pores, 10 pairs of setae, length of most posterior and lateral 10–12. Ventrianal shield length 115–120, width 375–390, with mesh-like reticulation anteriorly, becoming lineate-reticulate posteriorly, one pair setae just anterior of anus (length 6) (anteromedial ventrianal seta absent), three lateral pairs (length 10–20), paranal setae length 20; anterolateral corner of ventrianal shield fused with ventral shield. Marginal shields with mesh-like to lineate reticulation (Fig. 4A).

Legs. TrI with seta *pv1* with minute barbs, not thicker than seta *av1*. FeI with seta *pv3* similar to seta *pv1* and *pv2*. FeII with lamella distal to seta *pv1*, seta *ad1* smooth and thickened. FeIII without lamella, seta *pv1* not spine-like. FeIV enlarged (Fig. 5A), length 240–260, width 125–130 at distal end, without lamella, seta *pv1* not spine-like, seta *pd2* more proximal than seta *ad2*. TaII and III with seta *av2* setiform, longer than seta *av3*; TaII *av2* barbed. TaIII *av3* smooth. Legs II–IV with slightly thickened *ad* and *pd* setae, especially on femora and genua.

Gnathosoma (Fig. 5B). Seta *h1* smooth, straight, length 68–74, distance between *h1–h1* 38–40; *h2* smooth, length 44–55; *h3* length 7, posterolaterad *h2*; palpcoxal seta length 12. Corniculi on tubercles, tubercle length 10; corniculi palmate, tip toothed. Palp, seta *av1* on trochanter with 8–9 branches, seta *av2* with small barbs, spur with small denticles and blunt process. Chelicera, fixed digit length 175–180, movable digit length 63, fixed digit with two large and two minute teeth; excrescences arise from an enlarged base of digit and comprise a large brush-like process, a ribbon-like process with a serrate edge, and a ribbon-like process with a crenate and toothed edge; processes curled in specimens, but extend *c.* 75 past end of chelicerae.

Male (n = 2): *Idiosoma* length 930, width 695. Presternal shield length 29–32 at midline, width

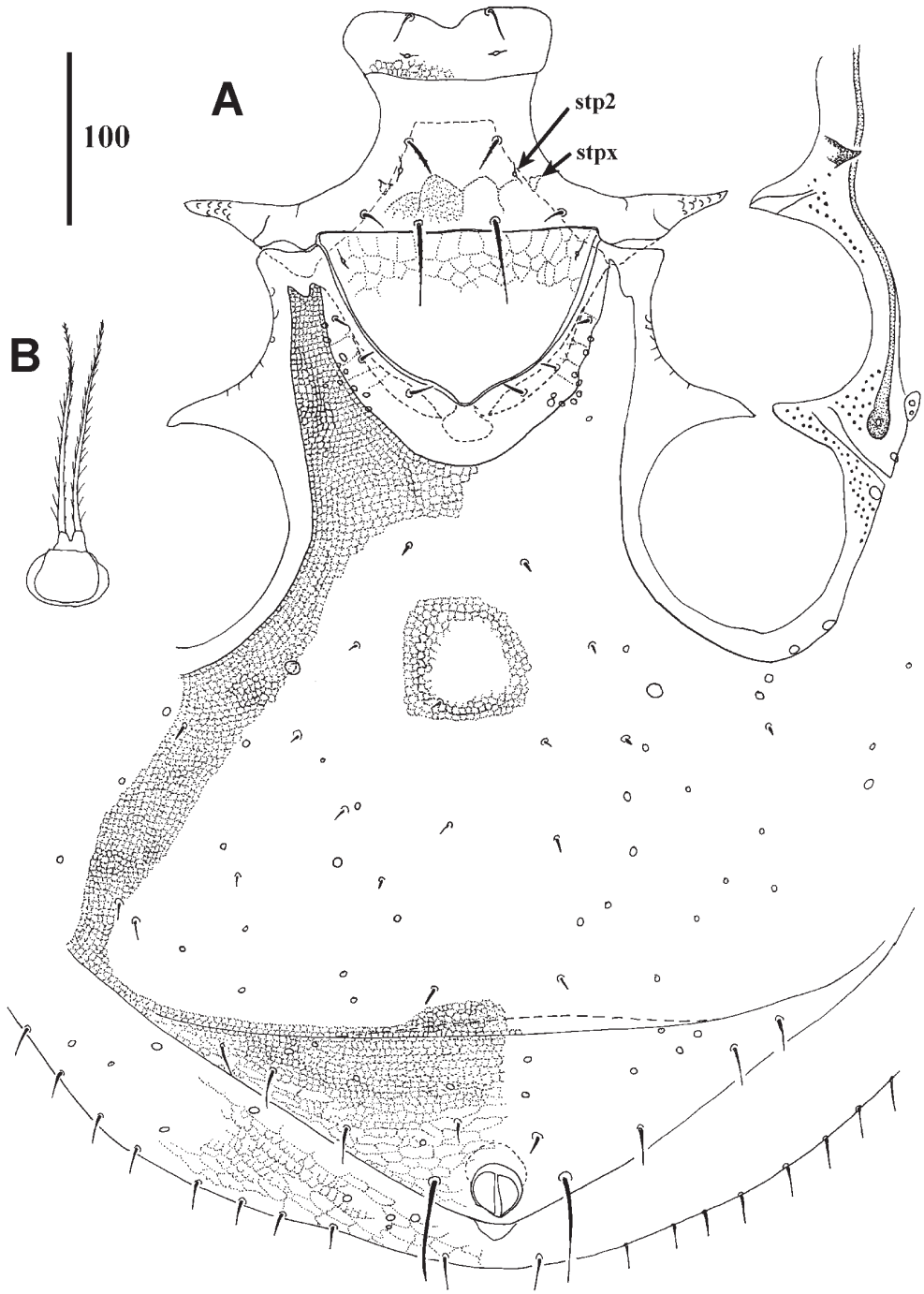

FIG. 4. *Fedrizzia humei* sp. nov. Female: **A**, venter; reticulation shown completely on presternal, sternal and ventrianal shields only on left-hand side; extensive reticulation shown incompletely on ventral shield to show setae, but central patch is smooth. **B**, tritosternum.

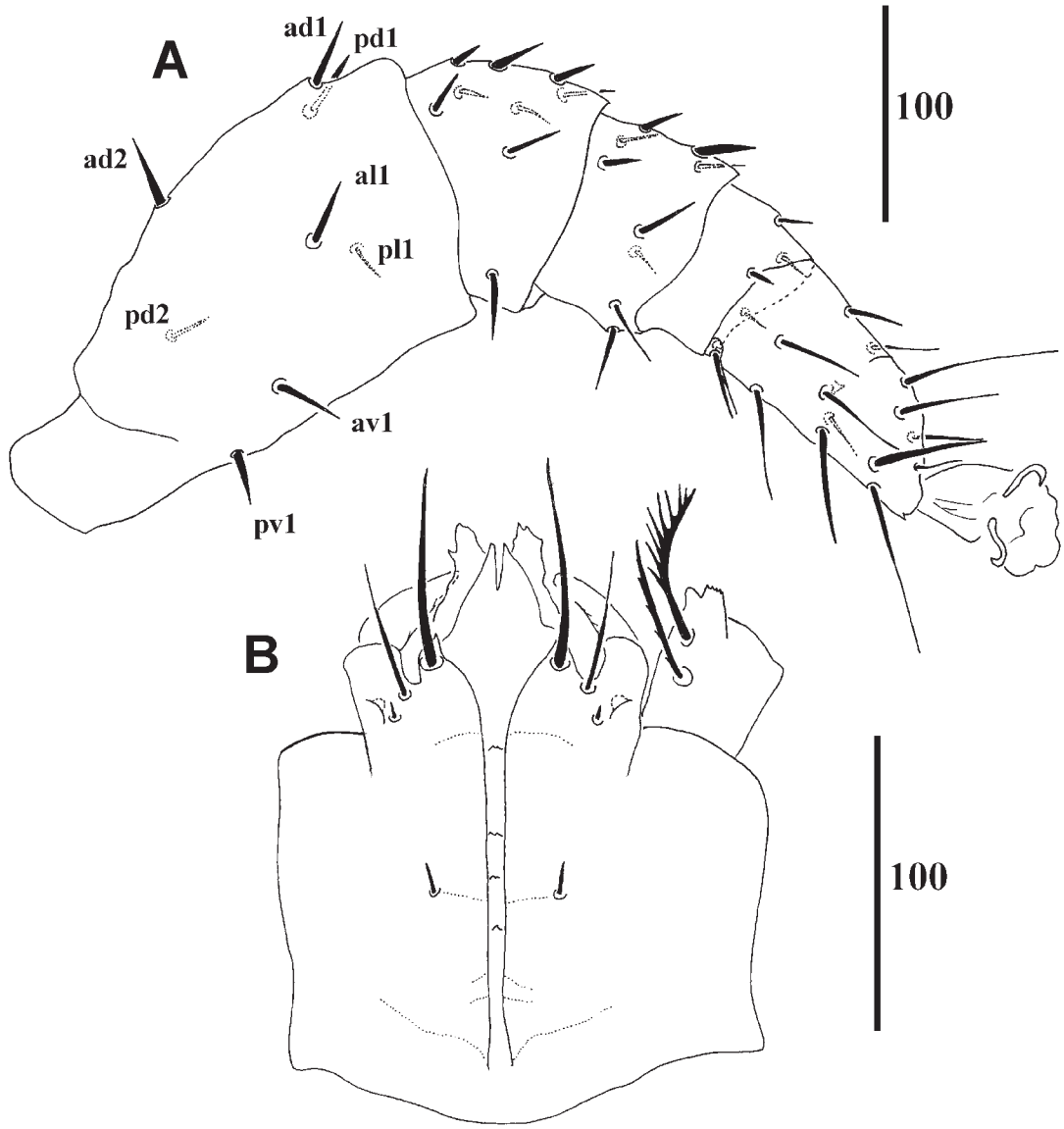

FIG. 5. *Fedrizzia humei* sp. nov. Female: **A**, leg IV, right-hand side anterior view; femoral setae labelled. **B**, hypostome and palp trochanter.

88–94; *st1* smooth, length 35–45; *st2* smooth, length *c.* 6; *st3* smooth, length 20. Genital opening length 58–61, width 68–71. Small, medial smooth area medially, *c.* 50 diameter, at level of posterior margin of Cx IV. Suture posterior to genital opening separates smooth sternogenital shield from ventral shield. Ventral, ventrianal and marginal shields with mesh-like reticulation (Fig. 6A). *Gnathosoma.* Seta *h3* length 10–12, and level with *h2* and closer to midline than *h2*. Palpcoxal seta length 13 (Fig. 6B).

Etymology. This species is named for Andrew Hume, who probably met Adolph Classen after Ludwig Leichhardt's final expedition failed. Andrew Hume died during his second attempt to relocate the man he thought was Adolph Classen.

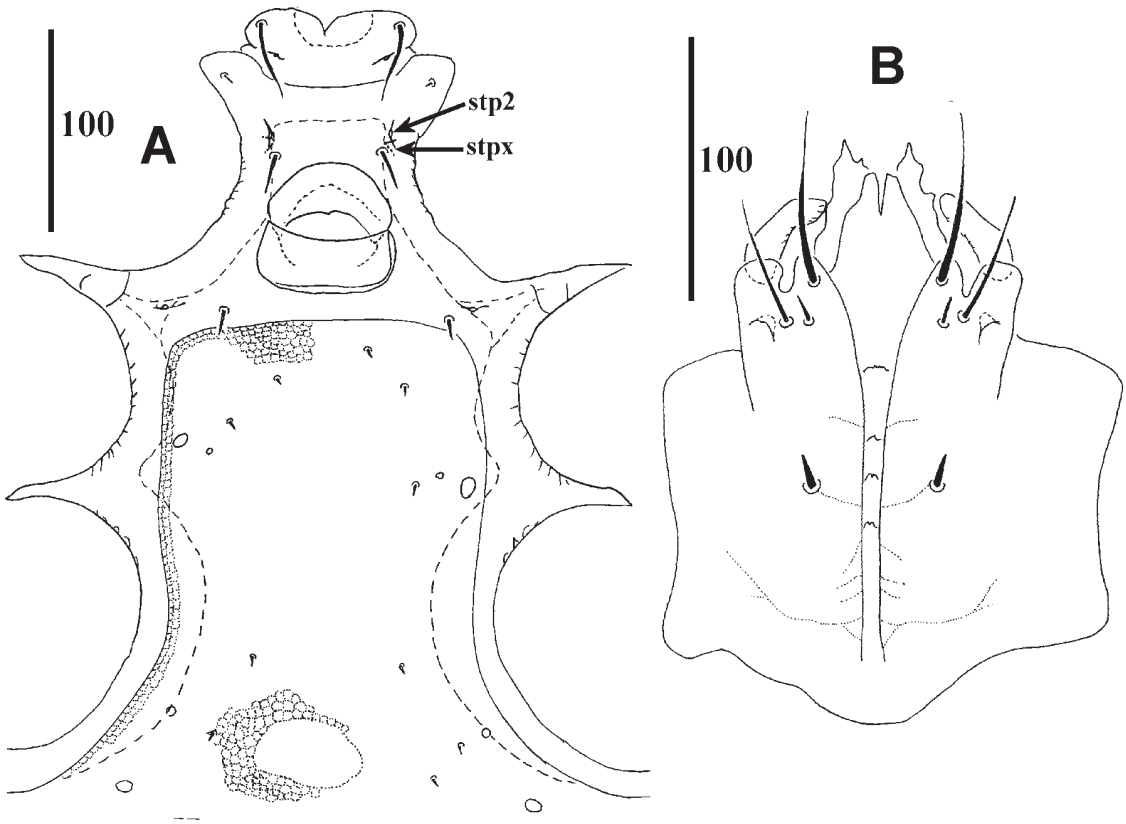

FIG. 6. *Fedrizzia humei* sp. nov. Male: **A**, sternogenital shield, reticulation extensive but only partially shown; small central patch is smooth; **B**, hypostome.

Remarks. *Fedrizzia humei* sp. nov. most closely resembles *F. grossipes* Canestrini, 1884, the type-species of *Fedrizzia*. The type specimens of this species are lost, and the species has never been collected again. Womersley (1959) thought he had collected a species similar to *F. grossipes*, and attributed it to *Fedrizzia* sp. cf. *grossipes*, but these were later shown to be *F. sellnicki* Womersley, 1959, and a poor match for *F. grossipes* (Seeman 2007). *Fedrizzia humei* sp. nov. matches *F. grossipes* in several ways (size, patterning, sutures), but Canestrini (1884) illustrated *F. grossipes* with an extensive smooth area surrounding the sternogynal shield (similar to *F. abradoalves*) and short setae *st3*. In contrast, *F. humei* has a small smooth area and long *st3*.

Fedrizzia oudemansi Womersley, 1959

(Fig. 7)

Fedrizzia oudemansi Womersley, 1959: 24.
Fedrizzia oudemansi — Seeman, 2007: 27 [specimens from Tenterfield and Mt Glorious only].

Material examined. New South Wales: SAMA-N1952290, holotype, ♀, Glen Innes, 9.x.1956, G.F. Bornemissza, on *P. dilatatus* under a eucalyptus log. SAMA-N1952291–N1952293, paratypes, 2 ♂♂, ♀, same data as holotype [note that female paratype does not belong to this species, see below). SAMA-N1952294, ♂, near Tenterfield, Washpool Ck, 8.x.1956, G.F. Bornemissza, on *P. dilatatus*. **Queensland:** QM-S74038–39, ♀, ♂, Mt Glorious, 6.v.1995, O. Seeman, ex passalid beetle; QM-S74036–37, 2 ♀♀, Mt Glorious, 21.xii.1995, O. Seeman, ex *M. australasicus*. QM-S95270–73, ♀, 3 ♂♂, Kurrajong Picnic Area, Goomburra Section, Main Range

National Park, 27°58′S 152°20′E, H. Urbina, J. Bartlett, O. Seeman, ex *M. australasicus*.

Diagnosis. Both sexes: idiosoma length 760–820; dorsal shield with 8–10 large pores medially; ventral shield with lineate reticulation laterally, smooth medially; marginal and ventrianal shields smooth; anterolateral corner of ventrianal shield fused with ventral shield; exopodal patterning between CxII–III spotted; pedofossae III absent; CxIV-marginal suture absent; femur III and IV without lamellae, seta *pv1* not significantly thickened; femur IV not elongate, similar to femur III; seta *h1* thickened. Female: setae *st2–4* length 6–11; lyrifissure *stp2* posterior to stp*x*; sternogynal shield smooth, flanked by one pair of pores and two pairs of setae. Male: sternoventral shield without suture posterior to genital opening; genital opening flanked by one pair of pores; seta *h1* curved, flattened slightly; seta *h3* positioned level with and mesad of *h2*.

Description. Female: *Idiosoma* length 760–820, width 615–645 (holotype 760 x 615). *Dorsum.* Dorsal shield with anterior hyaline projection bearing one pair of barbed setae, length 65; hypertrichous, with *c.* 180 minute setae; with numerous (*c.* 80) smaller pores and 8–10 larger medial pores (subcuticular gland 10–15 diameter); with sublateral line of 16–20 pores; dorsal patterning comprises fine transverse to oblique lines and extensive fine punctations; marginal setae length 6–8. *Venter.* Tritosternum base length 30–32, width 37–40. Presternal and sternal shield smooth; presternal shield crown-shaped, length 29–32 at midline, width 92–100; *st1* barbed, length 40–52; *st2–4* length 6–11; posterolateral margin of sternal shield pointed, *st3–4* 3–6 anterior to posterior margin, pore *stpx* anterior to *stp2*. Sternogynal shield length 112–120, width 156–167, smooth, flanked by one pair of pores and two pairs of setae. Ventral shield lineate laterally, smooth medially, with a large pore between CxIII–IV, without large pore posteromedial CxIV, three pairs of large pores and 11 pairs of small round pores, 10 pairs of setae, most posterior and lateral length 10–12. Ventrianal shield length 170–185, width 420–475, smooth, paranal setae length 38–42, lateral and anteromedial setae length 18, setae just anterior to anus length 8–10; anterolateral corner of ventrianal shield fused with ventral shield. Marginal shields smooth (Fig. 7A).

Legs. TrI with seta *pv1* with minute barbs, not thicker than seta *av1*. FeI with seta *pv3* similar to seta *pv1* and *pv2*. FeII with lamella distal to seta *pv1*, seta *ad1* with small barbs, thickened. FeIII without lamella, seta *pv1* not spine-like. FeIV not enlarged (Fig. 7C), length 100, width 70 at distal end, without lamella, seta *pv1* not spine-like, seta *pd2* just proximal to seta *ad2*. TaII with seta *av2* spine-like, longer than seta *av3*; TaII with seta *av2* spine-like, subequal to seta *av3*. Legs II–IV setae *ad* and *pd* thickened.

Gnathosoma. Seta *h1* smooth, straight, thickened slightly, length 48–50, distance between *h1–h1* 21; *h2* finely barbed, length 40; *h3* length 10, posterolaterad *h2*; palpcoxal seta length 14. Corniculi on tubercles, tubercle length 12; corniculi palmate, tip toothed. Palp, seta *av1* on trochanter with 11 branches, seta *av2* barbed; trochantal spur with sharp process and two blunt processes. Chelicera, fixed digit length 135, movable digit length 36, fixed digit with two large and two minute teeth; excrescences arise from an enlarged base of digit and comprise a large brush-like process, a ribbon-like process with a serrate edge and a toothed edge, and a ribbon-like process with a crenate and toothed edge; processes extend at least 50 past end of chelicerae.

Male: *Idiosoma* length 745–770, width 570–580. Presternal shield length 23–26 at midline, width 93–98; *st1* with nine barbs, length 41–45; *st2* smooth, length 8; *st3* smooth, length 33–37. Genital opening length 44–48, width 54–57, flanked by one pair of pores. Suture posterior to genital opening absent (Fig. 7B). *Gnathosoma.* Seta *h1* flattened, with fine tip, length 42–48. Seta *h2* length 9. Seta *h3* length 8–9, level with and mesad of *h2*.

Remarks. Seeman (2007) erred by identifying the specimens from Rockwood (described above as *F. classeni* sp. nov.) as *F. oudemansi*. As these were the best available specimens of his putative *F. oudemansi*, they were used as the reference point for the key. Consequently, a new key is required and is provided below. *Fedrizzia oudemansi* is similar to *F. classeni* sp. nov., but like most *Fedrizzia* species, it lacks lamellae on legs III–IV (present in *F. classeni* sp. nov.).

The paratype female (SAMA-N1952293) is not *F. oudemansi*. The slide has spoiled too much

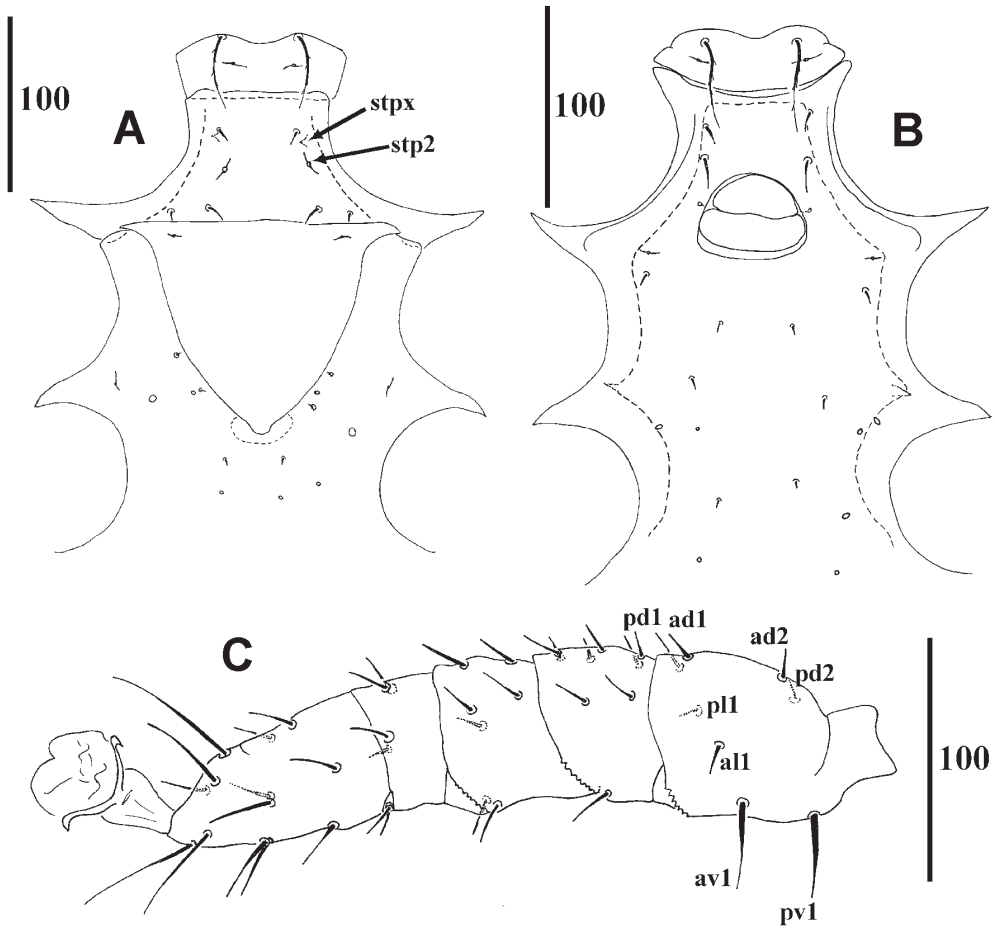

FIG. 7. *Fedrizzia oudemansi* Womersley, 1959. **A**, female, holotype, sternogenital shields; length and form of *st1*, *st3* and *st4* from non-type material. **B**, male, non-type, sternogenital shields. **C**, male, non-type, leg IV, left-hand side anterior view; femoral setae labelled.

to make any further judgement, but it is larger (length *c.* 900) and clearly has a reticulated sternogynal shield. *Fedrizzia oudemansi* is smaller (760–820) and has a smooth sternogynal shield.

Key to Female *Fedrizzia* Species

Idiosomal lengths and countries of origin are given for each species and are given to help eliminate some, but not all, species in couplets. The key is based on Seeman (2007), and illustrations of characters in the key are provided in that paper.

1. Femur III and IV with large lamellae, seta *pv1* thickened. Pedofossae III present. Exopodal patterning between CxII–III striped. Idiosoma length 1120–1280. [Papua New Guinea]. . . . . *Fedrizzia scutata* (Womersley)
— Femur III and IV without large lamellae, sometimes small distal lamella present, seta *pv1* not significantly thickened. Pedofossae III absent. Exopodal patterning between CxII–III spotted. 2
2. Femur III and IV with small distal lamellae. 3
— Femur III and IV without lamellae. 4
3. Posterior of sternogynal shield not flanked by a cluster of pores. Ventral shield with small flange that overlaps the posterior of

sternogynal shield. Idiosoma length 1140–1160. [Thailand]. . . . . *Fedrizzia gilloglyi* Seeman

— Posterior of sternogynal shield flanked by 4 pores. Ventral shield does not overlap sternogynal shield. Idiosoma length 725–810. [Northern NSW, Southeast Qld]. . . . . *Fedrizzia classeni* sp. nov.

4. Ventral shield entirely lineate-reticulate, sometimes smooth medially, never with mesh-like pattern. 5

— Ventral shield with mesh-like pattern laterally and sometimes postero-medially. 8

5. Process of palp trochanter without blunt process. Sternogynal shield length 173–176. Idiosoma length 1000–1040. [Southeast Qld]. . . . . *Fedrizzia parvipilus* Seeman

— Process of palp trochanter with blunt process. Sternogynal shield length < 150. 6

6. Femur IV elongated, obviously longer than femur III. Sternogynal shield length 140. Idiosoma length 800–850. [Papua New Guinea]. . . . . *Fedrizzia carabi* Womersley

— Femur IV not elongated, only slightly longer than femur III. Sternogynal shield length 120–130. 7

7. Setae *st2* length 7–11. Sternogynal shield smooth. Idiosoma length 760–820. [Australia]. . . . . *Fedrizzia oudemansi* Womersley

— Setae *st2* length 25. Sternogynal shield lineate-reticulate. Idiosoma length 850–860. [Buru, Indonesia]. . . . . *Fedrizzia strandi* (Oudemans)

8. Ventrianal shield with mesh-like reticulation. Idiosoma length 860–900. . . 9

— Ventrianal shield lineate-reticulate *or* with weak mesh-like reticulation anteriorly; if with mesh-like reticulation, then idiosoma > 1100. 10

9. Sternogynal shield surrounded by smooth area extending to posterior level of Cx IV; sternal setae *st3* short. Idiosoma length 900. [Australia]. . *Fedrizzia grossipes* Canestrini

— Sternogynal shield surrounded by smooth area extending no further than anterior margin of Cx IV; sternal setae *st3* long, length 49–52. Idiosoma length 860. [Southeast Qld]. . . . . *Fedrizzia humei* sp. nov.

10. Smooth area surrounding sternogynal shield delineated by a suture, the area extensive, extending well past level of CxIII–IV. Idiosoma length 1020–1070. [Southeast Qld]. . . . . *Fedrizzia abradoalves* Seeman

— Smooth area surrounding sternogynal shield either narrow, the area not extending past level of CxIII–IV, *or* not extensive and not delineated by a suture. 11

11. Lateral setae of ventrianal shield length 20–30; sternogynal shield with strong honeycomb-like reticulation. Idiosoma length 1160–1260. [Southeast Qld, Northern NSW . . . . . *Fedrizzia sellnicki* Womersley

— Lateral setae of ventrianal shield length 10–20; sternogynal shield reticulated, but not in a strong honeycomb pattern. Idiosoma length < 1100. 12

12. Setae *st3* length > 20, *st4* length > 10. Ventrianal shield length 127, width 260. Idiosoma length 930. [Northeast Qld]. . . . . *Fedrizzia derricki* Womersley

— Setae *st3* length < 15, *st4* length < 10. Ventrianal shield length 139, width 406. Idiosoma length 930–1000. [eastern Qld]. . . . . *Fedrizzia bornemisszai* Womersley

Key to Male *Fedrizzia* Species

1. Femur III and IV with large lamellae, seta *pv1* thickened. Pedofossae III present. Exopodal patterning between CxII–III striped. Idiosoma length 1260. [Papua New Guinea]. . . . . *Fedrizzia scutata* (Womersley)

— Femur III and IV without large lamellae, sometimes small distal lamella present, seta *pv1* not significantly thickened. Pedofossae III absent. Exopodal patterning between CxII–III spotted. 2

2. Femur III and IV with small distal lamellae. 3

— Femur III and IV without lamellae. 4

3. Sternoventral shield reticulate. Seta *h1* with bulbous base. Idiosoma length 1160. [Thailand]. . . . . *Fedrizzia gilloglyi* Seeman

— Sternoventral shield smooth. Seta *h1* blade-like, base not bulbous. Idiosoma length 700–770. [Southeast Qld]. . . . . *Fedrizzia classeni* sp. nov.

4. Sternoventral shield lineate-reticulate, smooth medially. 5

— Sternoventral shield with mesh-like pattern laterally and sometimes postero-medially. 8

5. Sternoventral shield without suture posterior to genital opening, intercoxal region smooth. 6
— Sternoventral shield with suture posterior to genital opening demarking smooth (anterior) and reticulate (posterior) regions. 7

6. Seta *h1* with swollen base, not distally flattened. Process of palp trochanter sharp, without blunt spurs. Idiosoma length 1000–1030. [Southeast Qld]. . . . . *Fedrizzia parvipilus* Seeman
— Seta *h1* distally flattened, without swollen base. Process of palp trochanter with single sharp spur and two blunt spurs. Idiosoma length 745–770. [Southeast Qld, NSW]. . . . . *Fedrizzia oudemansi* Womersley

7. Sternal setae *st2–3* length < 10. Idiosoma length 750–880. [Papua New Guinea]. . . . . *Fedrizzia carabi* Womersley
— Sternal setae *st2–3* length > 15. Idiosoma length 760. [Buru, Indonesia]. . . . . *Fedrizzia strandi* (Oudemans)

8. Suture posterior to genital opening well separated from genital opening, at level of Cx III–IV. Idiosoma length 900. [Qld]. . . . . *Fedrizzia grossipes* Canestrini
— Suture posterior to genital opening close to genital opening, at level of mid CxIII. Idiosoma length usually > 900. 9

9. Ventrianal shield with mesh-like reticulation medially, excepting small bare patches. 10
— Ventrianal shield without mesh-like reticulation medially, lineate-reticulate instead. 12

10. Ventral shield without smooth area between, or just posterior of, Cx IV. Idiosoma length 1160–1260. [Southeast Qld]. . . . . *F. sellnicki* Womersley
— Ventral shield with small, medial smooth area between, or just posterior of, Cx IV Idiosoma length < 1100. 11

11. With smooth area on ventrianal shield, just anterior of ventrianal shield. Ventrianal shield mostly lineate-reticulate, mesh-like reticulation weak and anterior on shield. Marginal shields lineate-reticulate, without mesh-like reticulation. Idiosoma length 1020–1050. [Southeast Qld]. . . . . *Fedrizzia abradoalves* Seeman
— Without smooth area on ventrianal shield, just anterior of ventrianal shield. Ventrianal shield mostly covered in mesh-like reticulation. Marginal shields with areas of mesh-like reticulation. Idiosoma length 930. [Southeast Qld]. . . . . *Fedrizzia humei* sp. nov.

12. Ventrianal shield length 127, width 260. Idiosoma length 930. [Northeast Qld]. . . . . *Fedrizzia derricki* Womersley
— Ventrianal shield length 139, width 406. Idiosoma length 905. [Eastern Qld]. . . . . *Fedrizzia bornemisszai* Womersley

DISCUSSION

With the addition of these two species of *Fedrizzia*, 12 species of fedrizziid mites are now known from the three Australian species of *Mastachilus* (Table 1). The southern form of *M. australasicus* hosts seven species, but I have never captured all seven from the same beetle, with four being the typical number. The southern form of *M. australasicus* is not common in rainforest, which has been the focus of my previous collecting, so some of these records may represent use of this host species only when it occurs in rainforest. This may be the case for *F. parvipilus*, *F. sellnicki* and *N. vidua*, which are typically found on the much larger *M. quaestionis*, a rainforest specialist. More than one species of passalid can occupy the same log, so it is also possible that these host records represent incidental use of *M. australasicus* as a host. *Mastachilus australasicus* is common at Goomburra State Forest in open forests that fringe rainforest habitats. Here, *M. australasicus* hosts the remaining four species of fedrizziid mite, and none of the species found on *M. quaestionis*, or their host beetle, were found there.

Mastachilus usually hosts species of *Neofedrizzia* (Table 1), and the absence of this genus from *M. polyphyllus* most likely reflects that these new species were collected from two beetles at one locality. Further collecting from this host species will almost certainly discover undescribed species of *Neofedrizzia.*

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LITERATURE CITED

Canestrini, G. 1884. Acari dell'Australia. *Atti Ist. Veneto* **2**: 705–723.

Dibb, J.R. 1938. Synopsis of Australian Passalidae (Coleoptera). *Transactions of the Royal Entomological Society of London* **87**: 103–124.

Hunter, P.E. 1993. Mites associated with New World passalid beetles (Coleoptera: Passalidae). *Acta Zoologica Mexicana Nueva Serie* **58**: 1–37.

Oudemans, A.C. 1927. Acarologische Aanteekeningen. LXXXVI. *Entomologische Berichten* **7**(156): 227.

Seeman, O.D. 2000. The immature life stages of the Fedrizziidae (Mesostigmata: Fedrizzioidea). *Acarologia* **41**: 39–52.

2001. Myriad Mesostigmata associated with log-inhabiting arthropods. *In,* Halliday, R.B., Walter, D.E., Proctor, H., Norton, R.A. & Colloff, M. (Eds), *Acarology: Proceedings of the 10th International Congress*. (CSIRO Publishing: Canberra).

2002. Mites and passalid beetles: diversity, taxonomy and biogeography. PhD thesis. The University of Queensland, Brisbane.

2007. Revision of the Fedrizziidae (Acari: Mesostigmata: Fedrizzioidea). *Zootaxa* **1480**: 1–55.

2009. Two new species of Fedrizziidae (Acari: Mesostigmata) from Australian passalid beetles (Coleoptera: Passalidae). *Systematic and Applied Acarology* **14**: 51–59.

Van Doesberg, P.H. 1992. A new species of *Aulacocyclus* from Australia (Coleoptera: Passalidae). *Zoologische Mededelingen* **66**: 413–415.

Womersley, H. 1959. Some Acarina from Australia and New Guinea paraphagic upon millipedes and cockroaches and beetles of the family Passalidae. *Transactions of the Royal Society of South Australia* **82**: 11–54.