



## ***Prolixus* (Acari: Trombidiformes: Tenuipalpidae) newly recorded from New Zealand: A new species from Cyperaceae and its ontogenetic patterns in chaetotaxy**

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### **Abstract**

The genus *Prolixus* (Acari: Tenuipalpidae) was represented by two species from Australian sedges prior to this study. A new species, *Prolixus meyerae* sp. nov., is here described and illustrated from leaves of *Gahnia* (Cyperaceae) in Auckland, New Zealand. In this paper, we present the ontogenetic additions in idiosomal and leg chaetotaxy from larva to adult. A key to world species of *Prolixus* is also proposed.

**Key words:** Flat mite, false spider mite, Cyperaceae, *Gahnia*, ontogenetic changes

### **Introduction**

With the rising interest in flat mites (Tenuipalpidae) recently, several new species are being described every year. The described flat mite fauna currently contains over 1100 species in 38 genera (Mesa *et al.* 2009; Beard & Ochoa 2011; Zhang *et al.* 2011; Navajas & Ochoa 2013; Beard *et al.* 2013; Beard *et al.* 2014). Ten species belonging to five genera of the Tenuipalpidae have been described from Cyperaceae: *Acaricis plana* Beard & Gerson, 2009, *A. danutae* Beard & Gerson, 2009, *A. urigersoni* Xu & Zhang, 2013, *Cyperacarus foliatus* Beard & Ochoa, 2011, *C. naomae* Beard & Ochoa, 2011, *Gahniacarus gersonus* Beard & Ochoa, 2011, *G. tuberculatus* Beard & Ochoa, 2011, *Prolixus forsteri* Beard, Fan & Walter, 2005, *P. corruginus* Beard, Fan & Walter, 2005, *Tenuipalpus obvelatus* Wang, 1983. Eight of the 10 species are from Australia, and only one species was recorded from New Zealand.

The genus *Prolixus* was erected by Beard *et al.* (2005) with only two species collected on *Gahnia aspera* from Australia and was believed to be endemic to Australia. In this paper, we describe and illustrate a new species of this genus, which is a new record to the New Zealand fauna, with samples collected from *Gahnia* (Cyperaceae) in New Zealand. The ontogenetic development of this species is examined and all the life stages and the variations in the chaetotaxy of the idiosoma and legs are presented. A key to world species of this genus is also provided.

### **Material and methods**

Mites were mounted in Hoyer's medium, and examined at 1000 times with a DIC Leica DM5000B microscope. All measurements were made from slide-mounted specimens using a stage-calibrated ocular ruler and are given in micrometers (µm) (Zhang & Fan 2004). Measurements of the paratype as a range are presented, followed by the holotype data in parentheses. Body length was measured from the anterior margin of the prodorsum to posterior margin of the opisthosoma, and body width was measured as the greatest distance posterior to coxae II. Setae were measured from the centre of the setal base to the tip of the seta; distances between setae were measured as the distance from the centre of one setal base to the other. Legs were measured from the basal end of trochanter to the distal end of tarsus. Terminology follows that applied to the Tetranychidae by Lindquist (1985).

Family **Tenuipalpidae** Berlese, 1913

Genus ***Prolixus*** Beard, Fan & Walter, 2005.

*Prolixus* Beard, Fan & Walter, 2005: 164; Mesa *et al.*, 2009: 111; Beard & Ochoa, 2011: 32.

**Type species:** *Prolixus forsteri* Beard, Fan & Walter, 2005.

**Diagnosis.** Body elongate and slender, parallel-sided, more than four times as long as wide. Palpus 3-segmented, with setal formula 0, 2, 2. Prodorsum bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ); setae  $sc_1$  barbed or setiform. Opisthosoma with 8–9 pairs of dorsal setae ( $c_3$ ,  $d_1$ ,  $d_3$ ,  $e_1$ ,  $e_3$ ,  $f_2$ ,  $f_3$ ,  $h_2$  and  $h_1$  or  $c_3$ ,  $d_1$ ,  $d_3$ ,  $e_1$ ,  $e_3$ ,  $f_3$ ,  $h_2$  and  $h_1$ ); setae  $c_1$ ,  $c_2$ ,  $d_2$ ,  $e_2$  absent; setae  $h_2$  long and attenuate. Ventral setae  $1a$ ,  $1b$ ,  $2b$ ,  $2c$ ,  $3a$ ,  $4a_1$ ,  $4a_2$ ,  $g_1$ ,  $g_2$ ,  $ps_1$  and  $ps_2$  present; setae  $1c$ ,  $3b$ ,  $4b$  and  $ag$  present or absent; setae  $g_1$  inserted anterior to  $g_2$ . Adult leg chaetotaxy variable, only tibiae with stable setal formula 5, 5, 3, 3.

The original definition of *Prolixus* was based on two Australian species (Beard *et al.* 2005). The new species from New Zealand with new morphological features allows a revision of the generic diagnosis, as presented above.

***Prolixus meyerae* sp. nov.**

(Figs. 1–15)

**Diagnosis.** The adult female of *Prolixus meyerae* sp. nov. is easily distinguishable from those of the two other species by: dorsal idiosoma with series of oblique striations, forming a V-shaped pattern between setae  $sc_2$  and  $d_1$ , and with longitudinal striations posterior to  $d_1$ ; setae  $sc_1$  and  $c_3$  short, smooth, setiform; opisthosoma with 8 pairs of dorsal setae ( $c_3$ ,  $d_1$ ,  $d_3$ ,  $e_1$ ,  $e_3$ ,  $f_3$ ,  $h_2$  and  $h_1$ ), setae  $e_3$ ,  $f_3$  and  $h_1$  lanceolate and barbed; ventral setae  $1c$ ,  $3b$  and  $4b$  present, setae  $ag$  absent; and chaetotaxy (legs I–IV): coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tarsi 7+ $\omega$ -7+ $\omega$ -4-4.

**Type specimens.** **Holotype** ♀. **New Zealand**, Auckland, Orewa, Alice Eaves Reserve, 20 Aug., 2013, by Nicholas A. Martin, ex. *Gahnia xanthocarpa* (Cyperaceae). **Paratypes.** 8 females, 3 males, 6 deutonymphs, 11 protonymphs and 5 larvae, same data as holotype; 2 females, 4 males, 3 deutonymphs, 2 protonymphs and 3 larvae, Orewa Alice Eaves Reserve, Auckland, New Zealand, 4 Jan., 2014, by Nicholas A. Martin, ex. *Gahnia setifolia* (Cyperaceae). The holotype and 37 paratypes (8 females, 5 males, 7 deutonymphs, 11 protonymphs and 6 larvae) will be deposited in the New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand (NZAC); 10 paratypes (2 females, 2 males, 2 deutonymphs, 2 protonymphs, and 2 larvae) will be deposited in the Natural History Museum, London (BNHM).

**Description.**

**Adult Female** (Figs. 1–3; n = 5)

**Gnathosoma.** (Figs. 1B, 2C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta  $m$  setiform,  $m=4-5$  (5),  $m-m=8-9$  (8). Palp 3-segmented, setal formula: 0, 2, 2; tarsus with 2 eupathidia 2, 2.

**Dorsal idiosoma.** (Figs. 1A, 2A) 410–440 (410) long, 87–97 (95) wide. Body elongate. PRODORSUM mostly smooth with faint longitudinal striations mesally; bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ); setae  $v_2$  and  $sc_1$  minute, smooth, setiform;  $sc_1$  about twice as long as  $v_2$ ;  $sc_2$  lanceolate, barbed and about 5 times as long as  $sc_1$ . Setal lengths:  $v_2$  2,  $sc_1$  3–4 (4),  $sc_2$  15–22 (16); distances:  $v_2-v_2$  30–38 (38),  $v_2-sc_1$  40–42 (42),  $sc_1-sc_1$  44–47 (45),  $sc_1-sc_2$  44–50 (48),  $sc_2-sc_2$  70–89 (89). OPISTHOSOMA with broad band of oblique striations, forming a series of V-shaped pattern striae or folds between setae  $sc_2$  and  $d_1$ ; longitudinal striations posterior to  $d_1$  as shown in Fig. 1A; with 8 pairs of dorsal setae ( $c_3$ ,  $d_1$ ,  $d_3$ ,  $e_1$ ,  $e_3$ ,  $f_3$ ,  $h_2$  and  $h_1$ ); setae  $c_3$ ,  $d_3$ ,  $d_1$  and  $e_1$  smooth, setiform; setae  $e_3$ ,  $f_3$  and  $h_1$  lanceolate, barbed; setae  $h_2$  elongate, ending in minute club. Lengths:  $d_1$  6,  $e_1$  3–4 (4),  $c_3$  3,  $d_3$  2–3 (3),  $e_3$  11–22 (11),  $f_3$  15–22 (16),  $h_2$  95–125 (125),  $h_1$  7–10 (8); distances:  $d_1-d_1$  23–30 (30),  $e_1-e_1$  17–22 (20),  $c_3-c_3$  80–89 (88),  $d_3-d_3$  70–82 (80),  $d_3-e_3$  83–100 (85),  $e_3-e_3$  59–65 (63),  $e_3-f_3$  20–23 (20),  $f_3-f_3$  52–60 (60),  $f_3-h_2$  27–31 (29),  $h_2-h_2$  36–41 (41),  $h_2-h_1$  8–11 (11),  $h_1-h_1$  22–23 (23).

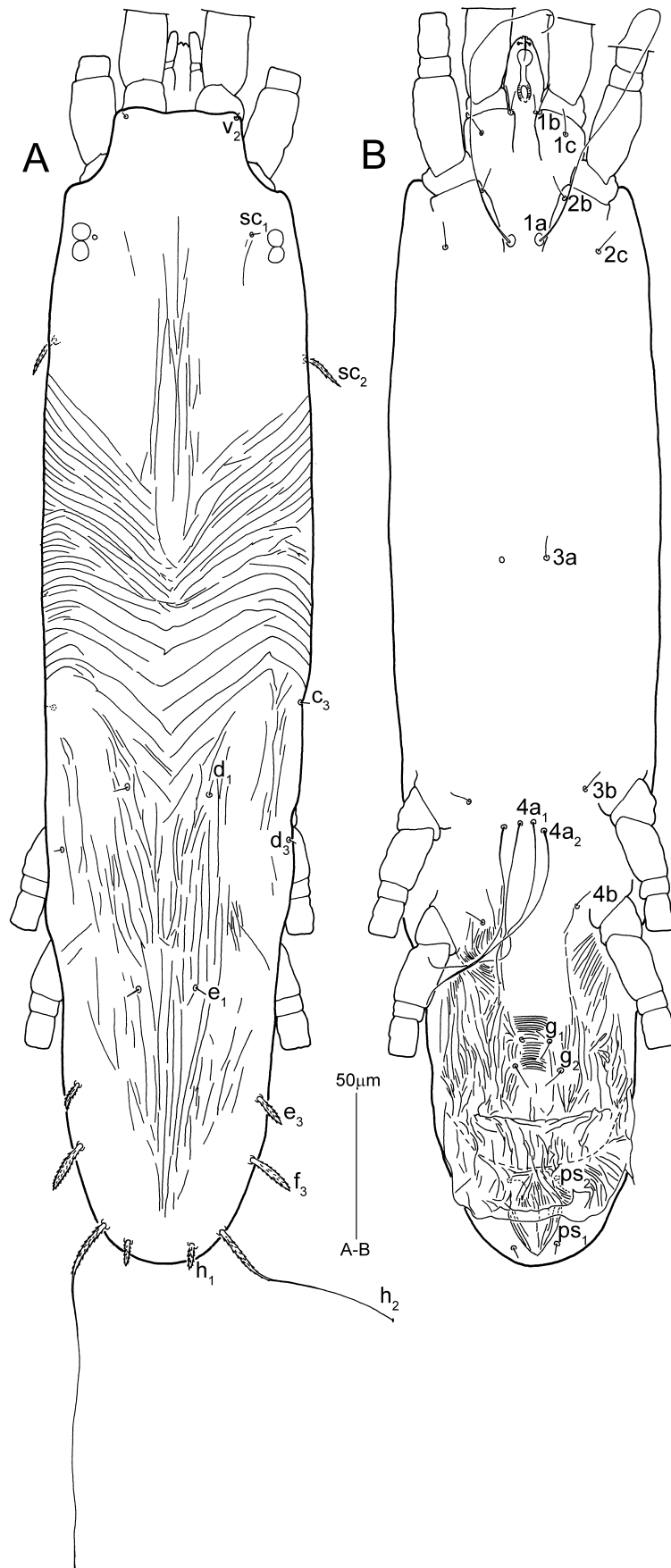


FIGURE 1. *Prolixus meyeræ* sp. nov. (adult female). A, dorsal view of idiosoma; B, ventral view of idiosoma.

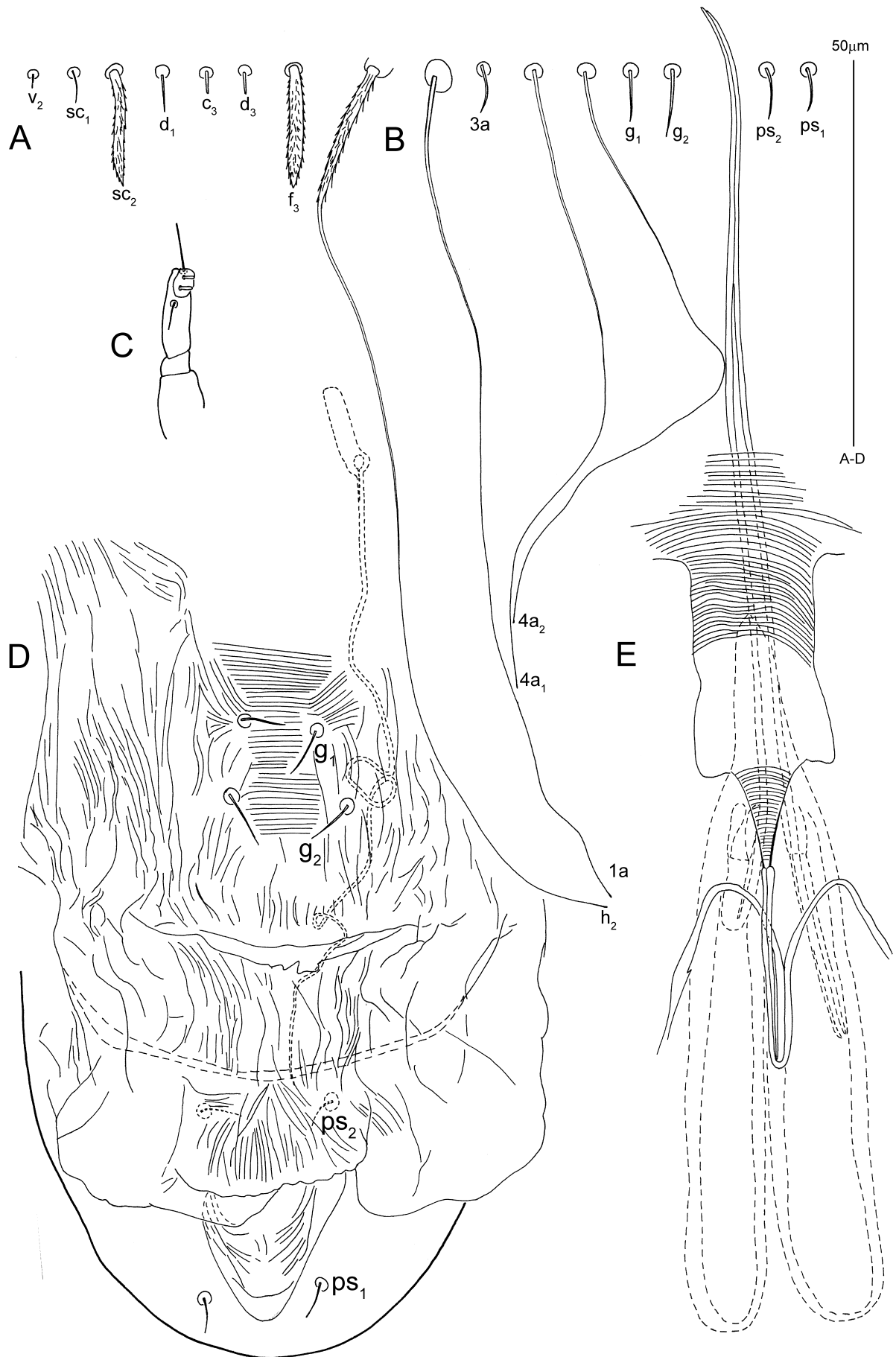
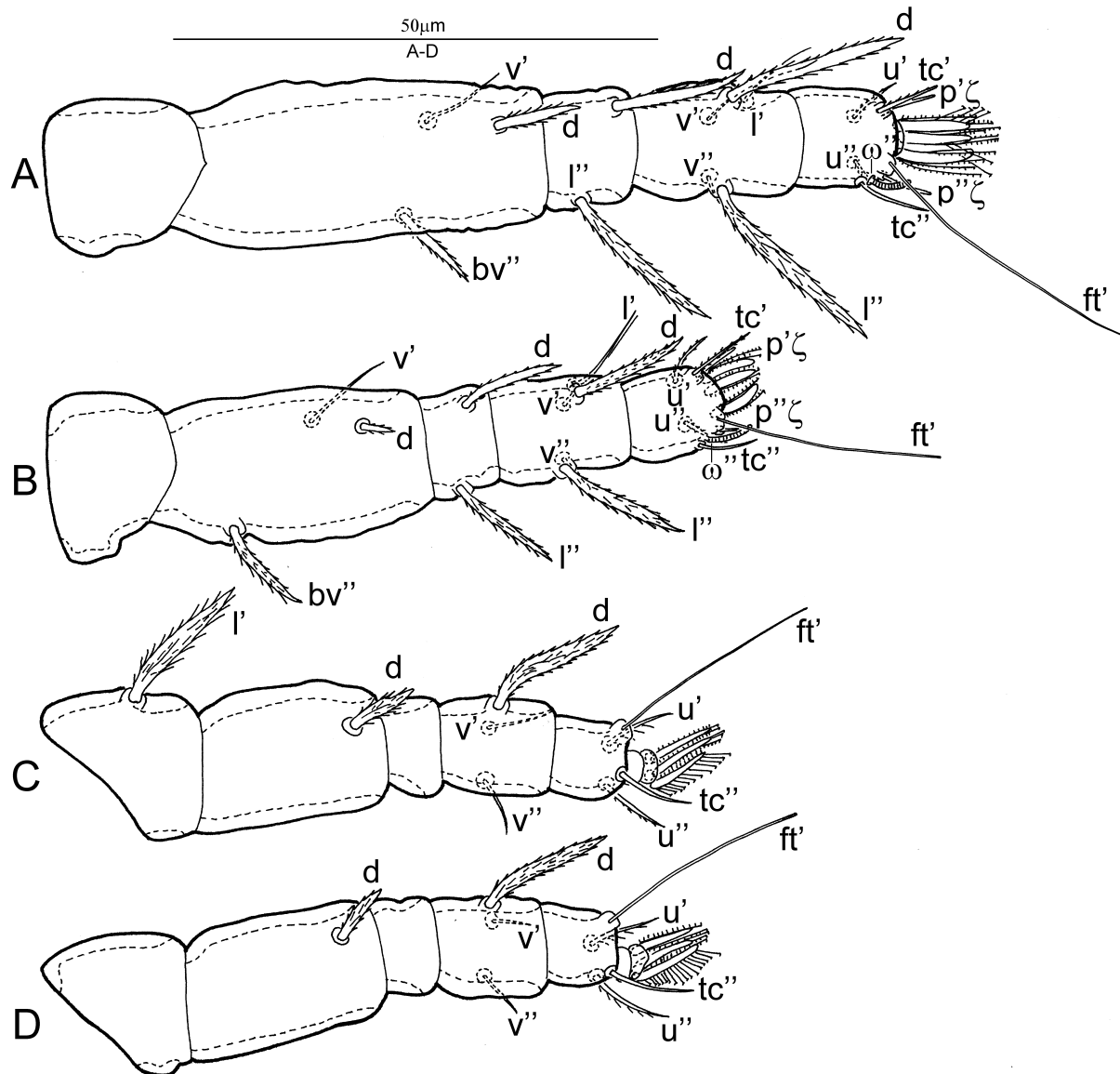


FIGURE 2. *Prolixus meyerae* sp. nov. (adult female). A, dorsal setae; B, ventral setae; C, palp; D, posterior venter; E, chelicerae and collar.

**Venter.** (Figs. 1B, 2B, D) Venter with fine transverse striations between coxae II and IV. All coxal setae setiform. Setae  $1a$ ,  $4a_1$  and  $4a_2$  flagelliform,  $3a$  setiform. Lengths:  $1a$  105–125 (110),  $1b$  6–7 (6),  $1c$  6–7 (7),  $2b$  8–10 (10),  $2c$  9–10 (10),  $3a$  6 (6–9),  $3b$  6–7 (6),  $4a_1$  72–90 (90),  $4a_2$  60–94 (94),  $4b$  6–7 (7). Distances:  $1a$ – $1a$  10–11 (10),  $3a$ – $3a$  14–16 (15),  $4a_1$ – $4a_1$  4–7 (4),  $4a_1$ – $4a_2$  4–5 (5),  $4a_2$ – $4a_2$  13–15 (13). Posterior opisthosoma with genital flap striate; bearing 2 pairs of smooth, setiform genital setae ( $g_1$  and  $g_2$ ), subequal in length; anal area with 2 pairs of widely separated pseudanal setae ( $ps_1$  and  $ps_2$ ); aggenital setae  $ag$  absent. Setal lengths:  $g_1$  5–8 (6),  $g_2$  5–8 (8),  $ps_1$  4,  $ps_2$  4–6 (6). Distances:  $g_1$ – $g_1$  9–12 (10),  $g_1$ – $g_2$  8–15 (11),  $g_2$ – $g_2$  8–15 (11),  $ps_1$ – $ps_2$  23–28 (23).

**Spermatheca.** (Fig. 2D) A narrow, unsclerotised tube extending from genital opening (mesad setae  $ps_2$ ) and ending in a cylinder-shaped vesicle.

**Legs.** (Fig. 3) Lengths of legs I–IV: 89–93 (89), 68–72 (70), 58–64 (64), 58–62 (62). Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi  $7+\omega$ - $7+\omega$ -4-4. Most dorsal and lateral setae on trochanter III, femora, genua I–II and tibiae lanceolate and barbed, lateral setae  $l'$  on tibiae setiform; ventral setae on femora and tibiae setiform, except  $bv''$  on femora I–II lanceolate and barbed. Setae  $ft'$  on tarsi I–IV flagelliform; unguinal setae  $u$  pectinate and equal in length; tectal setae  $tc$  smooth, setiform except  $tc'$  on tarsus I–II pectinate. Lengths of solenidia: ta I  $\omega''$  4–5 (4), ta II  $\omega''$  4–5 (4). Claws and empodium pad-like with row of paired tenent hairs.



**FIGURE 3.** *Prolixus meyerae* sp. nov. (adult female, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

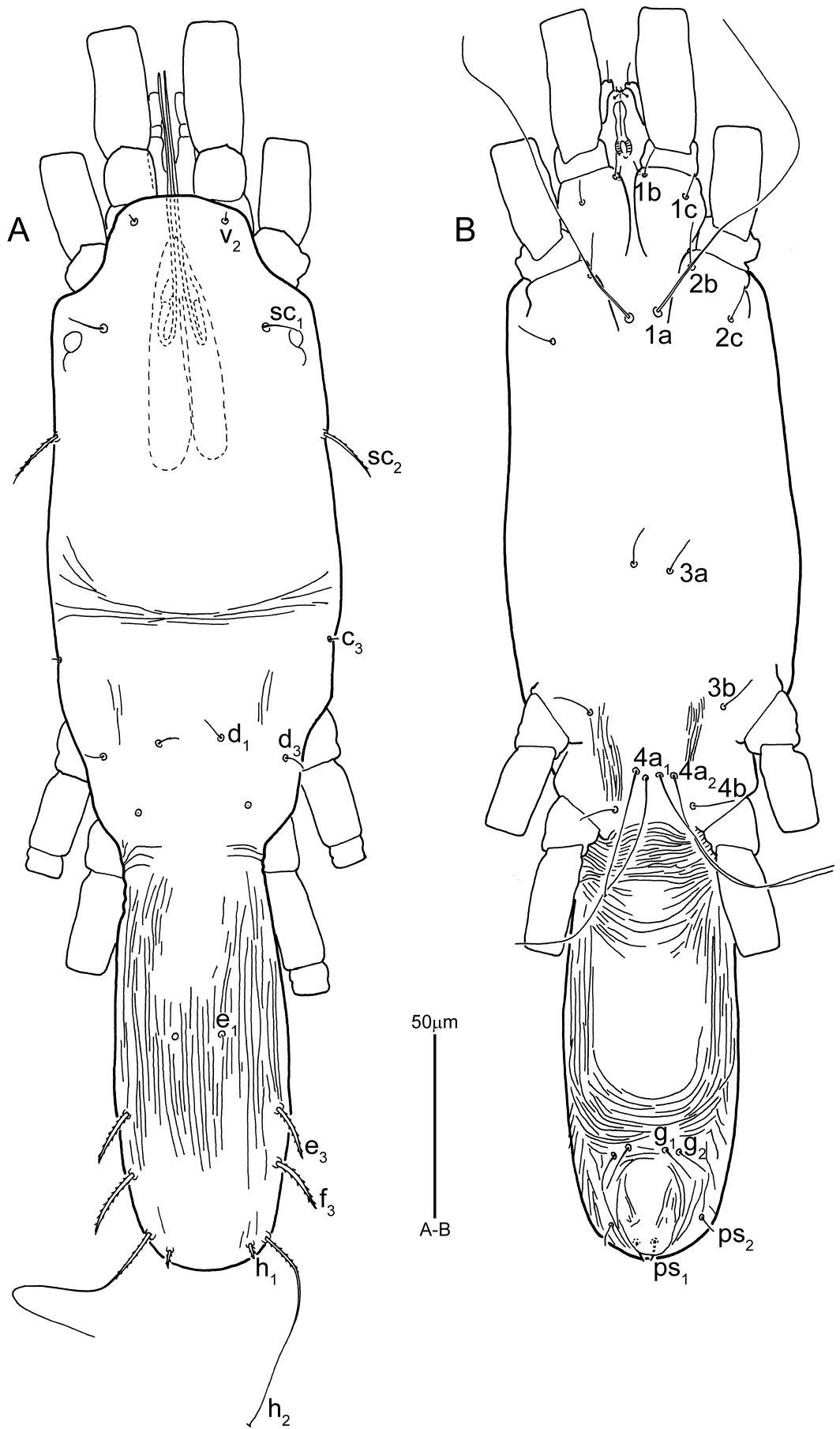
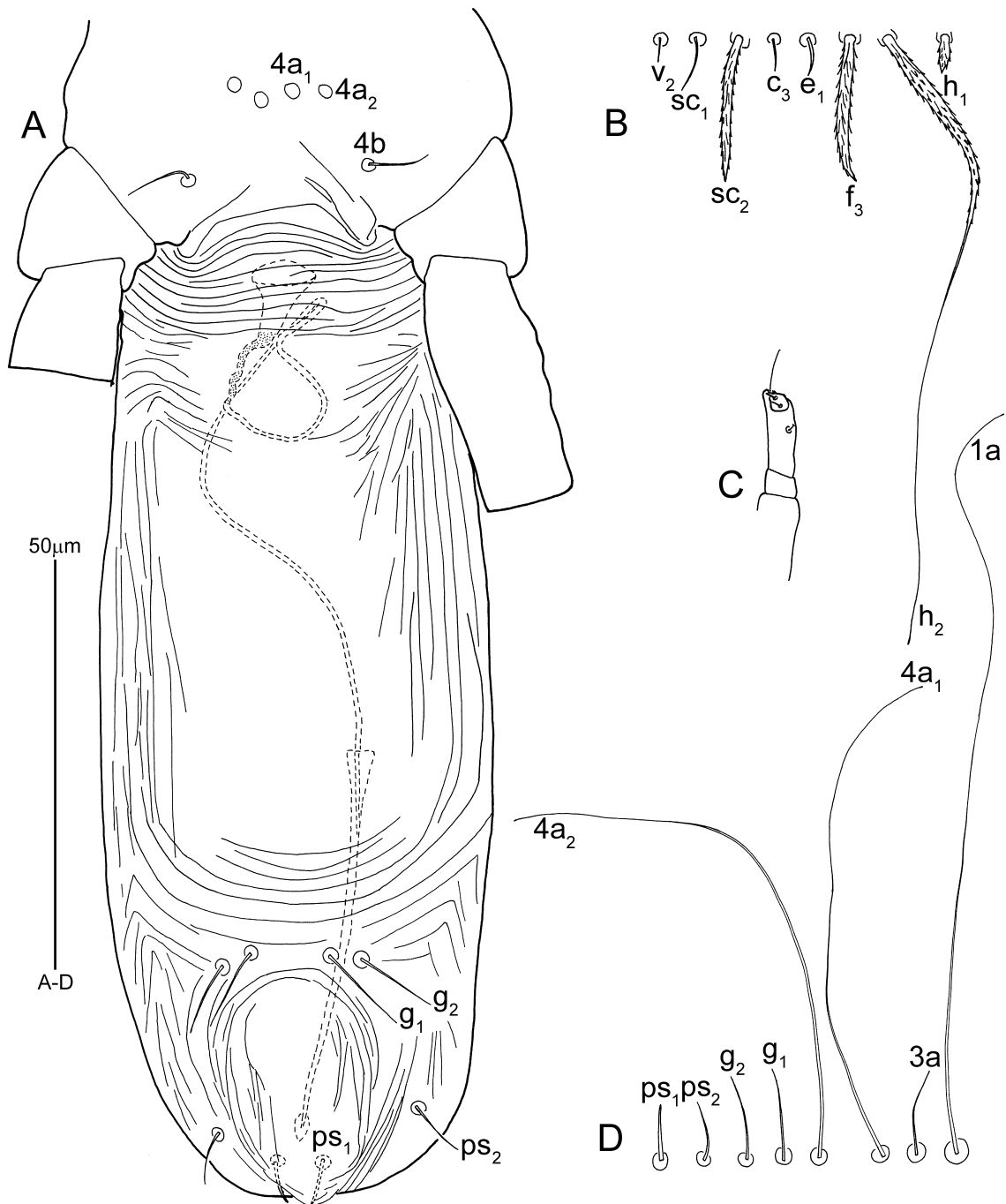


FIGURE 4. *Prolixus meyerae* sp. nov. (adult male). A, dorsal view of idiosoma; B, ventral view of idiosoma.

**Adult Male** (Figs. 4–6; n=3)

**Gnathosoma.** (Figs. 4B, 5C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta  $m$  setiform,  $m=5-6$ ,  $m-m=7-8$ . Palp 3-segmented, setal formula: 0, 2, 2; tarsus with 2 eupathidia 2, 2.

**Dorsal idiosoma.** (Figs. 4A, 5B) 300–330 long, 71–82 wide. Body elongate. PRODORSUM smooth, with a narrow band of transverse striations in sejugal furrow just anterior to setae  $c_3$ ; bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ), setae  $v_2$  and  $sc_1$  setiform,  $sc_1$  about 3 times as long as  $v_2$ ,  $sc_2$  lanceolate and more than twice as long as  $sc_1$ . Setal lengths:  $v_2$  2–3,  $sc_1$  6–9,  $sc_2$  17–19; distances:  $v_2-v_2$  21–25,  $v_2-sc_1$  31–32,  $sc_1-sc_1$  40–46,  $sc_1-sc_2$  33–39,  $sc_2-sc_2$  61–75. OPISTHOSOMA with narrow band of transverse striae at level of coxae IV; with 8 pairs of dorsal setae ( $c_3$ ,  $d_3$ ,  $d_3$ ,  $e_1$ ,  $e_3$ ,  $f_3$ ,  $h_2$  and  $h_1$ ); setae  $c_3$ ,  $d_3$ ,  $d_1$  and  $e_1$  short, setiform; setae  $e_3$ ,  $f_3$  and  $h_1$  lanceolate, barbed; and setae  $h_2$  elongate, ending in minute club. Lengths:  $d_1$  5–7,  $e_1$  3–4,  $c_3$  3,  $d_3$  3–5,  $e_3$  11–19,  $f_3$  16–21,  $h_2$  76–105,  $h_1$  4–5; distances:  $d_1-d_1$  17–22,  $e_1-e_1$  10–17,  $c_3-c_3$  66–76,  $d_3-d_3$  48–50,  $d_3-e_3$  100–110,  $e_3-e_3$  40–42,  $e_3-f_3$  17–20,  $f_3-f_3$  40–42,  $f_3-h_2$  17–22,  $h_2-h_2$  31–33,  $h_2-h_1$  5–7,  $h_1-h_1$  21–24.



**FIGURE 5.** *Prolixus meyerae* sp. nov. (adult male). A, posterior venter; B, dorsal setae; C, palp; D, ventral setae.

**Venter.** (Figs. 4B, 5A, D) Anterior venter similar to female. All coxal setae setiform. Setae *1a*, *4a<sub>1</sub>* and *4a<sub>2</sub>* flagelliform, *3a* setiform. Lengths: *1a* 99–105, *1b* 8–9, *1c* 6–7, *2b* 7–10, *2c* 6–9, *3a* 8–11, *3b* 5–9, *4a<sub>1</sub>* 63–68, *4a<sub>2</sub>* 62–68, *4b* 7–9. Distances: *1a*–*1a* 8–9, *3a*–*3a* 10–13, *4a<sub>1</sub>*–*4a<sub>1</sub>* 4–5, *4a<sub>1</sub>*–*4a<sub>2</sub>* 3–4, *4a<sub>2</sub>*–*4a<sub>2</sub>* 10–12. Posterior opisthosoma with an aedeagus (internal); with band of transverse striae at level of coxae IV; central region of opisthosoma with smooth cuticle, flanked by longitudinal striations laterally and transverse striae posteriorly, forming U-shaped pattern anterior to setae *g<sub>1</sub>*–*g<sub>2</sub>*; bearing 2 pairs of setiform genital setae (*g<sub>1</sub>* and *g<sub>2</sub>*) and 2 pairs of pseudanal setae (*ps<sub>1</sub>* and *ps<sub>2</sub>*), *ps<sub>1</sub>* thicker than *ps<sub>2</sub>*; aggenital setae ag absent. Setal lengths: *g<sub>1</sub>* 8–9, *g<sub>2</sub>* 7–10, *ps<sub>1</sub>* 6–7, *ps<sub>2</sub>* 5–6. Distances: *g<sub>1</sub>*–*g<sub>1</sub>* 10–12, *g<sub>1</sub>*–*g<sub>2</sub>* 4–5, *g<sub>2</sub>*–*g<sub>2</sub>* 4–5, *ps<sub>1</sub>*–*ps<sub>2</sub>* 10–13.

**Aedeagus.** (Fig. 5D) A narrow, elongate, sclerotised aedeagus tapering to a point posteriorly (at genital opening); membranous duct running from the sclerotised aedeagus to flared, lightly sclerotised, cone-shaped cup distally, connecting to a soft membranous vesicle.

**Legs.** (Fig. 6) Lengths of legs I–IV: 88–93, 68–75, 65–70, 73–74. Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi 7+2 $\omega$ -7+2 $\omega$ -4-4. Most dorsal and lateral setae on trochanters III, femora, genua I–II and tibiae lanceolate and barbed, lateral setae *l'* on tibiae setiform; ventral setae on femora and tibiae setiform, except *bv''* on femur II lanceolate and barbed. Setae *ft'* on tarsi I–IV flagelliform; unguinal setae *u* pectinate and equal in length; tectal setae *tc* smooth, setiform. Lengths of solenidia: ta I  $\omega'$  5–6,  $\omega''$  6, ta II  $\omega'$  5,  $\omega''$  5–6. Claws and empodium pad-like with row of paired tenent hairs.

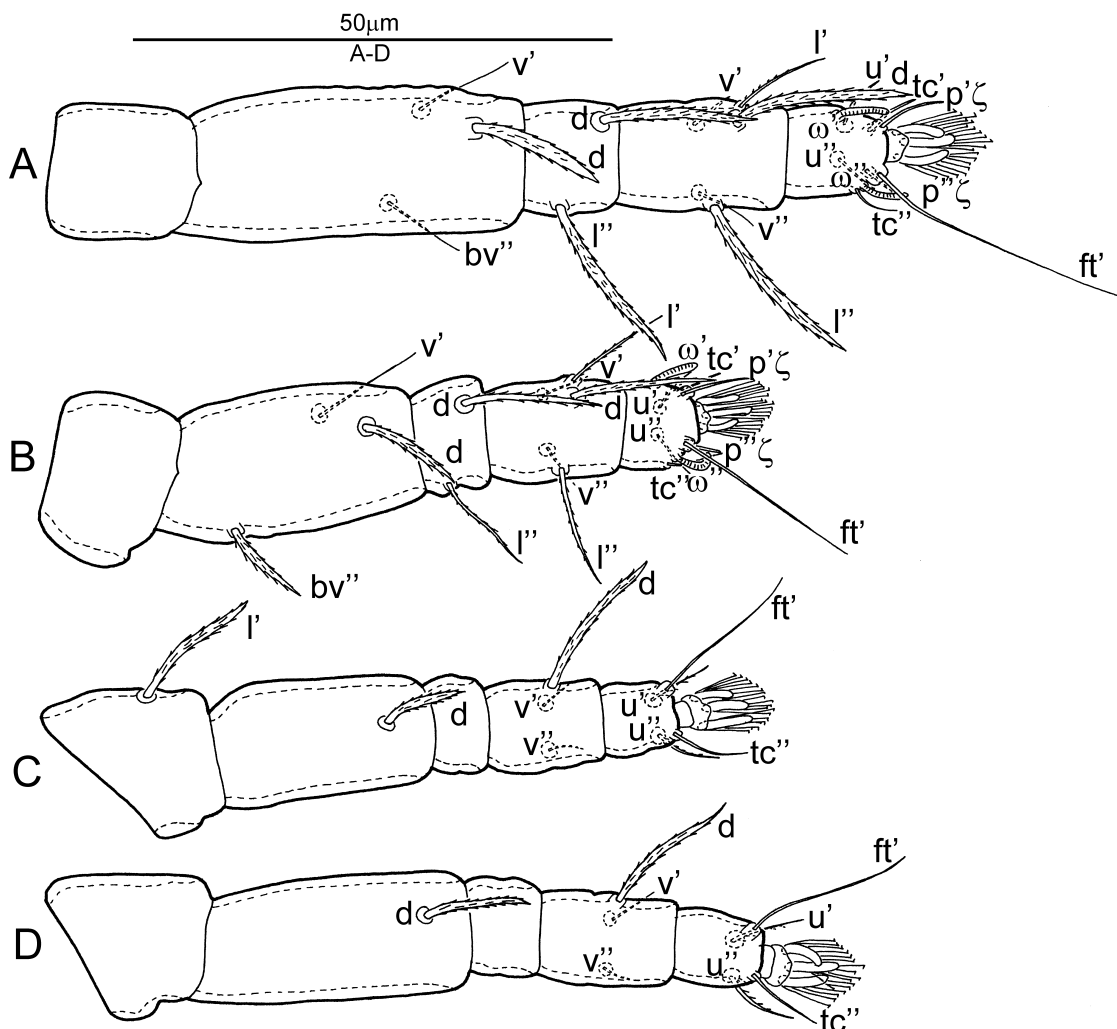


FIGURE 6. *Prolixus meyerae* sp. nov. (adult male, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

**Deutonymph** (Figs. 7–9; n=5)

**Gnathosoma.** (Figs. 7B, 8C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta *m* setiform, *m*=2–3, *m*–*m*=6–9. Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 2.



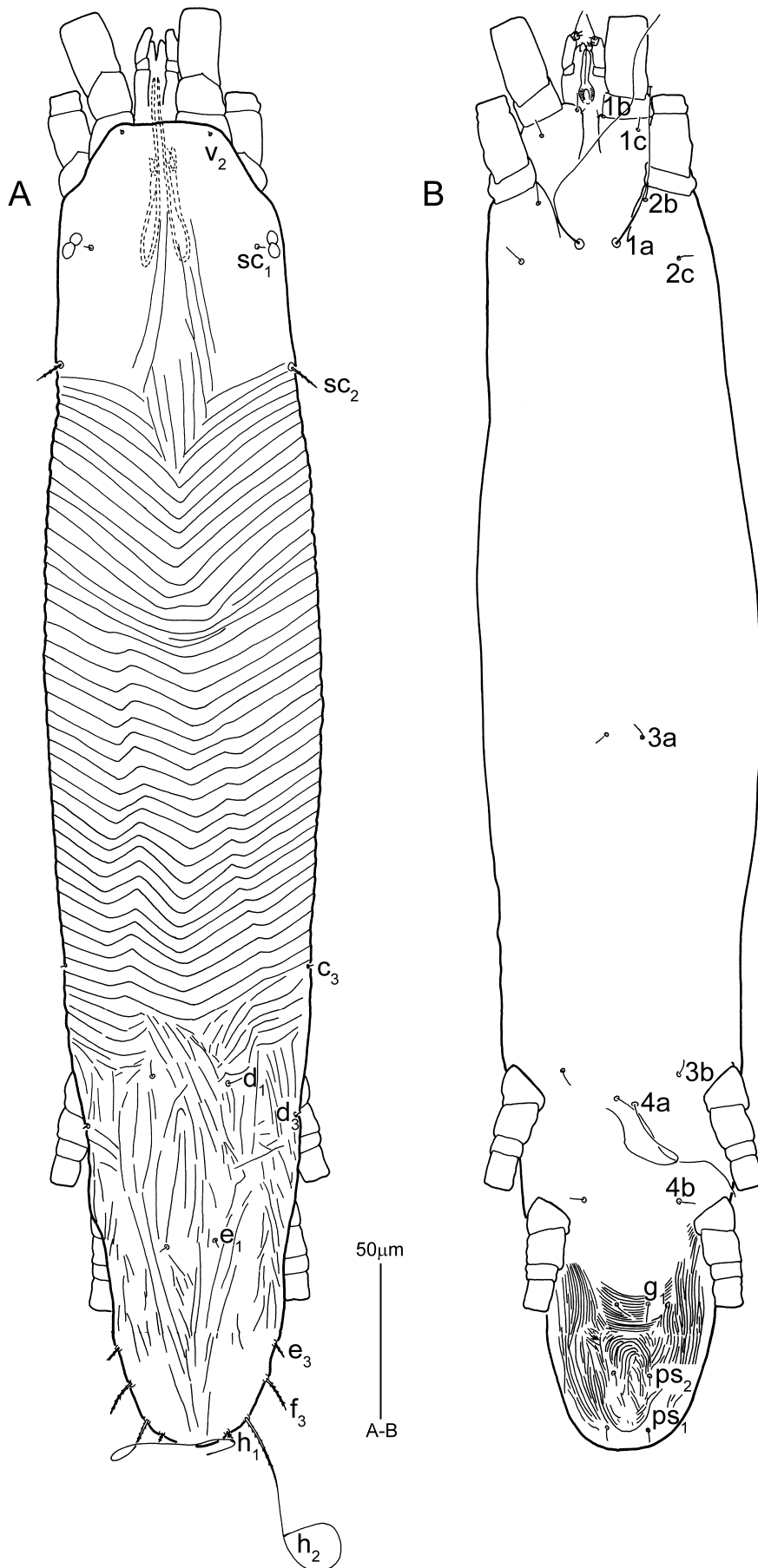
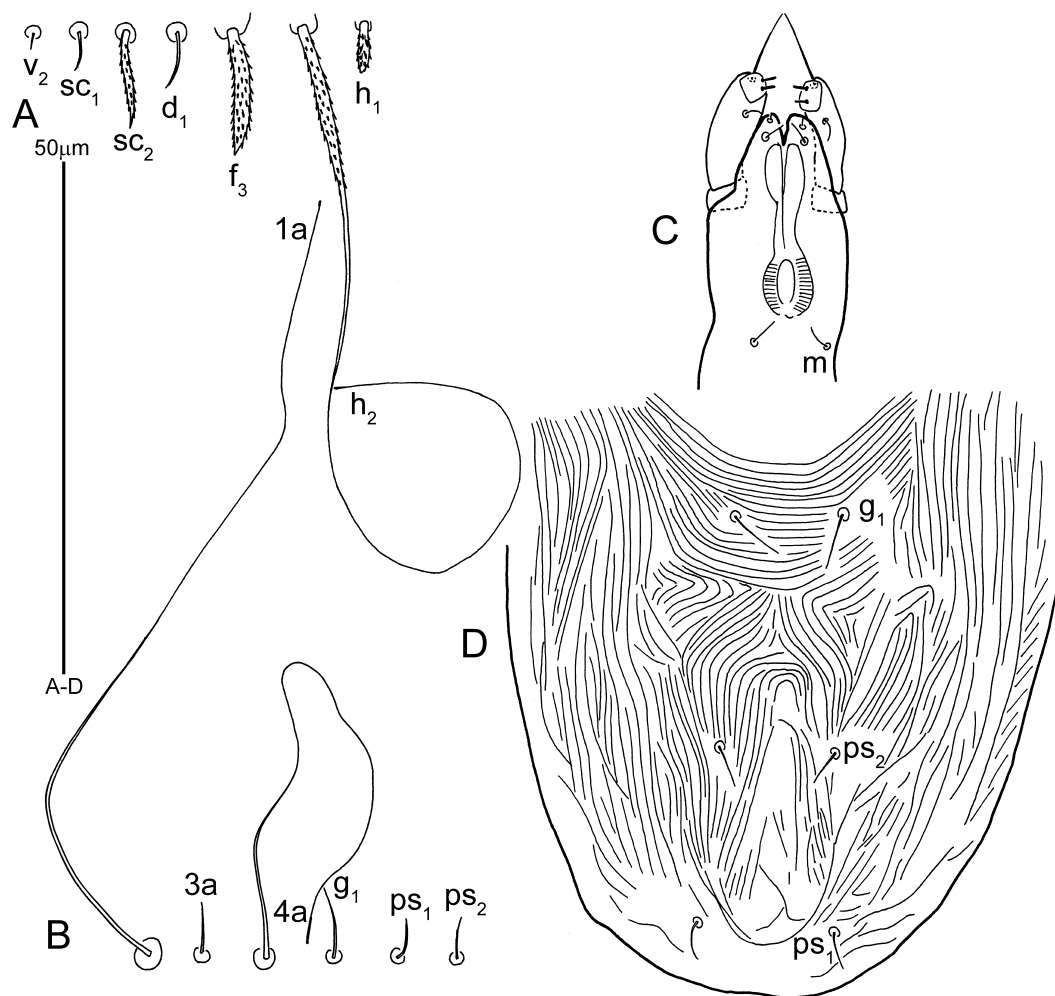


FIGURE 7. *Prolixus meyeræ* sp. nov. (deutonymph). A, dorsal view of idiosoma; B, ventral view of idiosoma.

**Dorsal idiosoma.** (Figs. 7A, 8A) 385–450 long, 70–96 wide. Body elongate, prodorsum covered with longitudinal striae medially; body with strong corrugated transverse striations between  $sc_2$  and  $d_1$ , and weak, broken longitudinal striae posterior to  $d_1$ . PRODORSUM bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ), setae  $v_2$  and  $sc_1$  setiform, minute; setae  $sc_2$  lanceolate and more than 2.5 times as long as  $sc_1$ . Setal lengths:  $v_2$  1–2,  $sc_1$  3–5,  $sc_2$  10–12; distances:  $v_2$ – $v_2$  30–31,  $v_2$ – $sc_1$  31–40,  $sc_1$ – $sc_1$  55–57,  $sc_1$ – $sc_2$  38–44,  $sc_2$ – $sc_2$  77–86. OPISTHOSOMA with same setae as adults; setae  $c_3$ ,  $d_3$ ,  $d_1$  and  $e_1$  setiform, minute; setae  $e_3$  and  $f_3$  lanceolate, barbed; setae  $h_1$  minute, barbed; and setae  $h_2$  elongate, ending in minute club. Lengths:  $d_1$  6–7,  $e_1$  3–4,  $c_3$  2,  $d_3$  2,  $e_3$  4–9,  $f_3$  8–13,  $h_2$  92–105,  $h_1$  4–5; distances:  $d_1$ – $d_1$  19–25,  $e_1$ – $e_1$  16–17,  $c_3$ – $c_3$  80–84,  $d_3$ – $d_3$  68–72,  $d_3$ – $e_3$  66–80,  $e_3$ – $e_3$  50–51,  $e_3$ – $f_3$  10–14,  $f_3$ – $f_3$  43–44,  $f_3$ – $h_2$  10–15,  $h_2$ – $h_2$  30–32,  $h_2$ – $h_1$  4–7,  $h_1$ – $h_1$  19–21.

**Venter.** (Figs. 7B, 8B, D) Similar to female. All coxal setae setiform. Setae  $1a$  and  $4a_1$  flagelliform,  $3a$  setiform. Lengths:  $1a$  67–93,  $1b$  6–7,  $1c$  5–6,  $2b$  6–7,  $2c$  6–7,  $3a$  4–6,  $3b$  5–7,  $4a_1$  60–67,  $4b$  6–7. Distances:  $1a$ – $1a$  12–16,  $3a$ – $3a$  13–14,  $4a_1$ – $4a_1$  5–6. Posterior opisthosoma with transverse striae surrounding setae  $g_1$ , and longitudinal striations laterally; bearing 1 pair of genital setae ( $g_1$ ) and 2 pairs of pseudanal setae ( $ps_1$  and  $ps_2$ ); aggenital setae ag absent. Setal lengths:  $g_1$  5–7,  $ps_1$  4–5,  $ps_2$  4. Distances:  $g_1$ – $g_1$  10,  $ps_1$ – $ps_2$  16–18.



**FIGURE 8.** *Prolixus meyerai* sp. nov. (deutonymph). A, dorsal setae; B, ventral setae; C, ventral aspect of distal infracapitulum; D, posterior venter.

**Legs.** (Fig. 9) Lengths of legs I–IV: 61–68, 48–52, 40–46, 39–44. Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi  $7+\omega$ - $7+\omega$ -4-4. Most dorsal and lateral setae on trochanter III, femora, genua I–II and tibiae lanceolate and barbed, though lateral setae  $l'$  on tibiae setiform. Ventral setae on femora and tibiae setiform, except  $bv''$  on femur II lanceolate and barbed. Setae  $ft'$  on tarsi I–IV flagelliform; unguinal setae  $u$  and tectal setae  $tc$  setiform. Lengths of solenidia:  $ta$  I  $\omega''$  4,  $ta$  II  $\omega''$  4. Claws and empodium pad-like with row of paired tenent hairs.

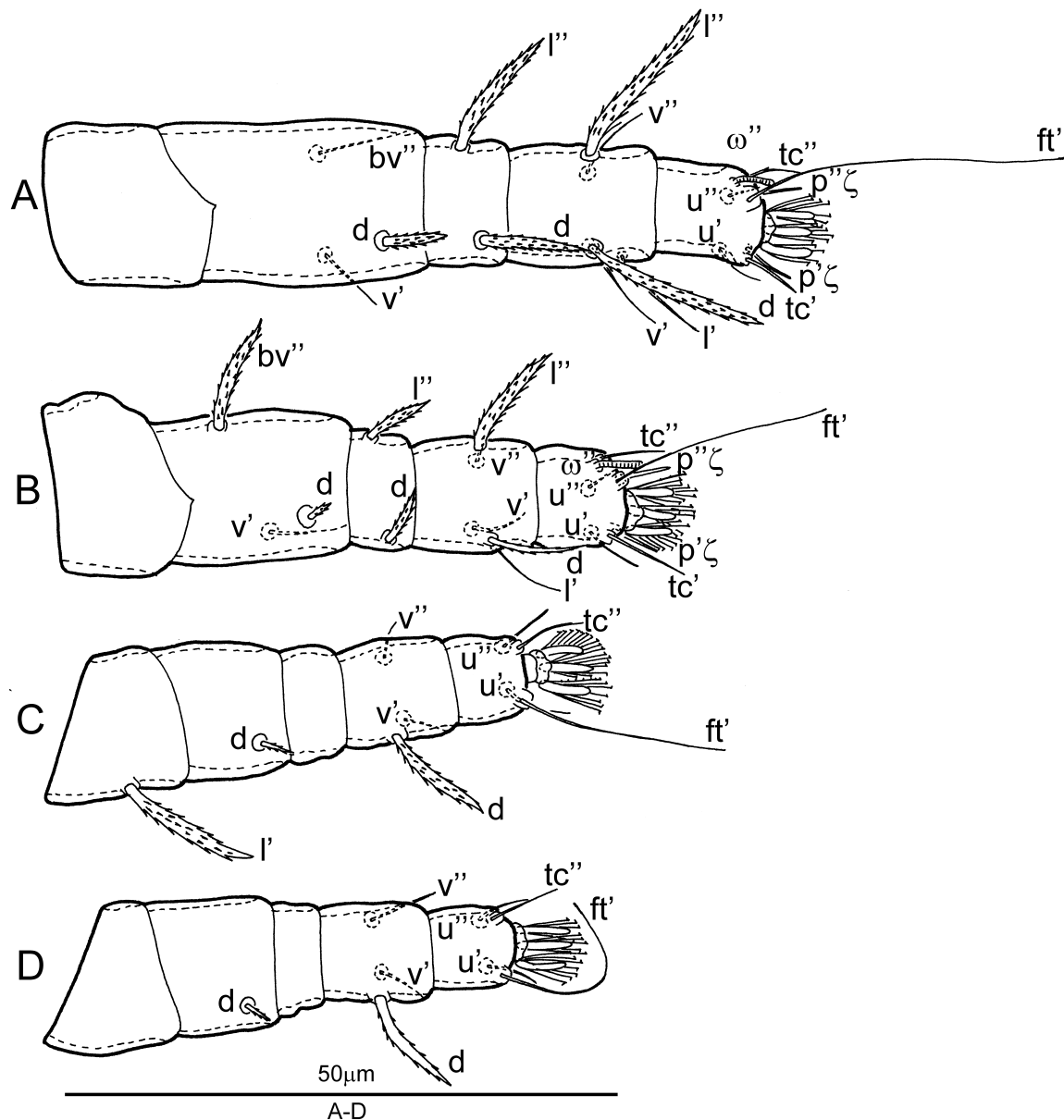


FIGURE 9. *Prolixus meyerae* sp. nov. (deutonymph, left side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

**Protonymph** (Figs. 10–12; n=5)

**Gnathosoma.** (Figs. 10B, 11D) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta *m* setiform,  $m=2-3$ ,  $m-m=6-7$ . Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 2.

**Dorsal idiosoma.** (Figs. 10A, 11B) 285–345 long, 72–78 wide. Body elongate, similar to deutonymph, prodorsum with longitudinal oblique striae medially; body with strong corrugated transverse striations between  $sc_2$  and  $d_1$ , and longitudinal striae posterior to  $d_1$ . PRODORSUM bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ), setae  $v_2$  and  $sc_1$  minute, setiform; setae  $sc_2$  lanceolate and more than 2.5 times as long as  $sc_1$ . Setal lengths:  $v_2$  1–2,  $sc_1$  3–5,  $sc_2$  8–10; distances:  $v_2-v_2$  22–25,  $v_2-sc_1$  30–34,  $sc_1-sc_1$  43–46,  $sc_1-sc_2$  28–40,  $sc_2-sc_2$  65–67. OPISTHOSOMA with same setae as adults. Setae  $c_3$ ,  $d_3$ ,  $d_1$  and  $e_1$  smooth, minute; setae  $e_3$  and  $h_1$  short, barbed; setae  $f_3$  lanceolate, barbed; and setae  $h_2$  elongate, ending in minute club. Lengths:  $d_1$  5–6,  $e_1$  2–3,  $c_3$  1–2,  $d_3$  1–2,  $e_3$  3–4,  $f_3$  5–7,  $h_2$  84–91,  $h_1$  3; distances:  $d_1-d_1$  13–20,  $e_1-e_1$  12–14,  $c_3-c_3$  63–67,  $d_3-d_3$  50–55,  $d_3-e_3$  46–56,  $e_3-e_3$  33–35,  $e_3-f_3$  7–9,  $f_3-f_3$  29–30,  $f_3-h_2$  6–9,  $h_2-h_2$  20–22,  $h_2-h_1$  4–5,  $h_1-h_1$  11–14.

**Venter.** (Figs. 10B, 11A, C) Similar to deutonymph. All coxal setae setiform. Setae  $1a$  flagelliform,  $3a$  setiform. Lengths:  $1a$  63–74,  $1b$  5–7,  $1c$  5–7,  $2b$  8–10,  $3a$  6–8,  $3b$  5–7. Distances:  $1a-1a$  9–10,  $3a-3a$  10–12. Posterior opisthosoma with 2 pairs of pseudanal setae ( $ps_1$  and  $ps_2$ ), setiform and subequal in length; aggenital and genital setae absent. Setal lengths:  $ps_1$  3–4,  $ps_2$  3. Distances:  $ps_1-ps_2$  9–10.

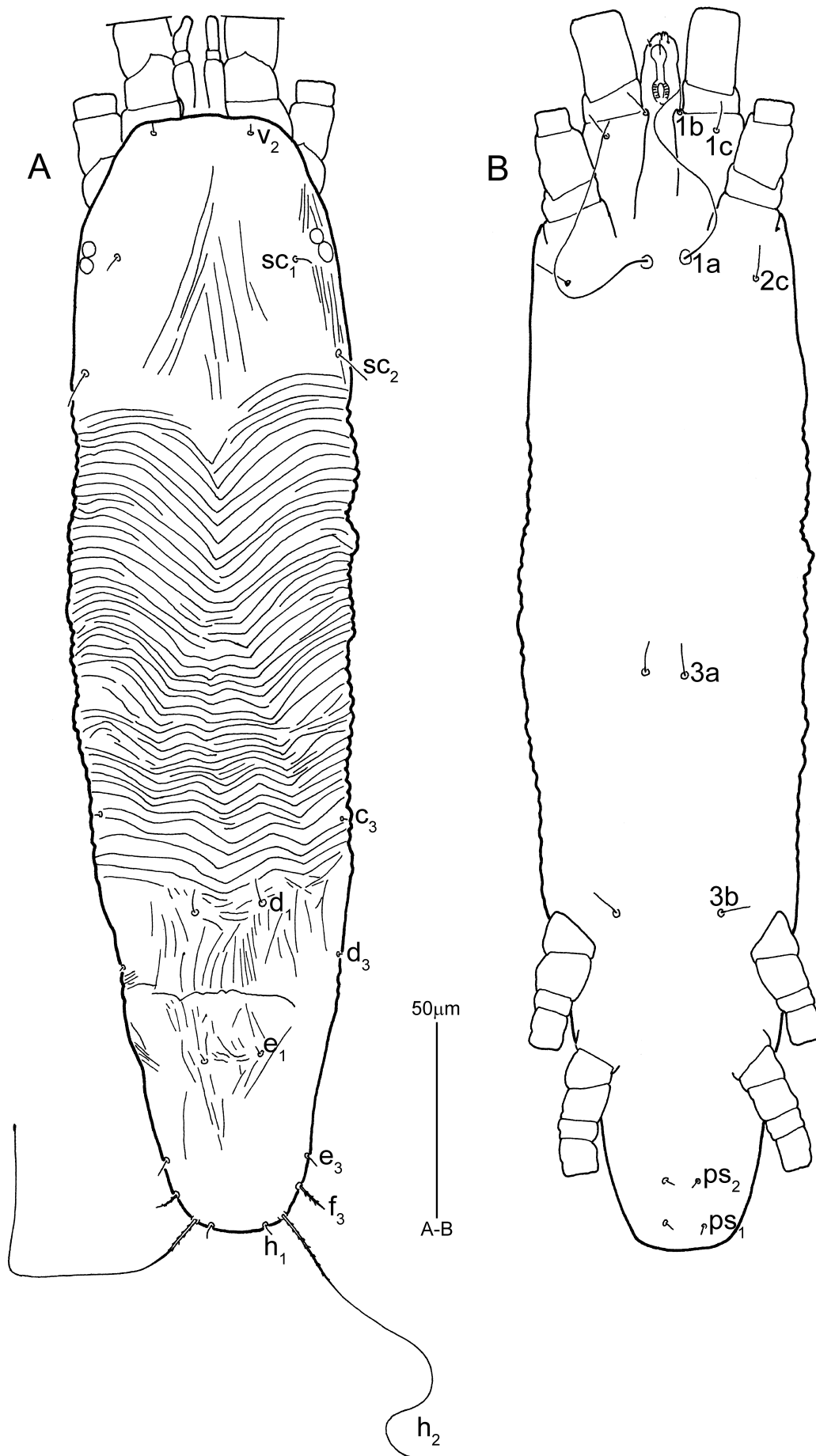


FIGURE 10. *Prolixus meyerae* sp. nov. (protonymph). A, dorsal view of idiosoma; B, ventral view of idiosoma.

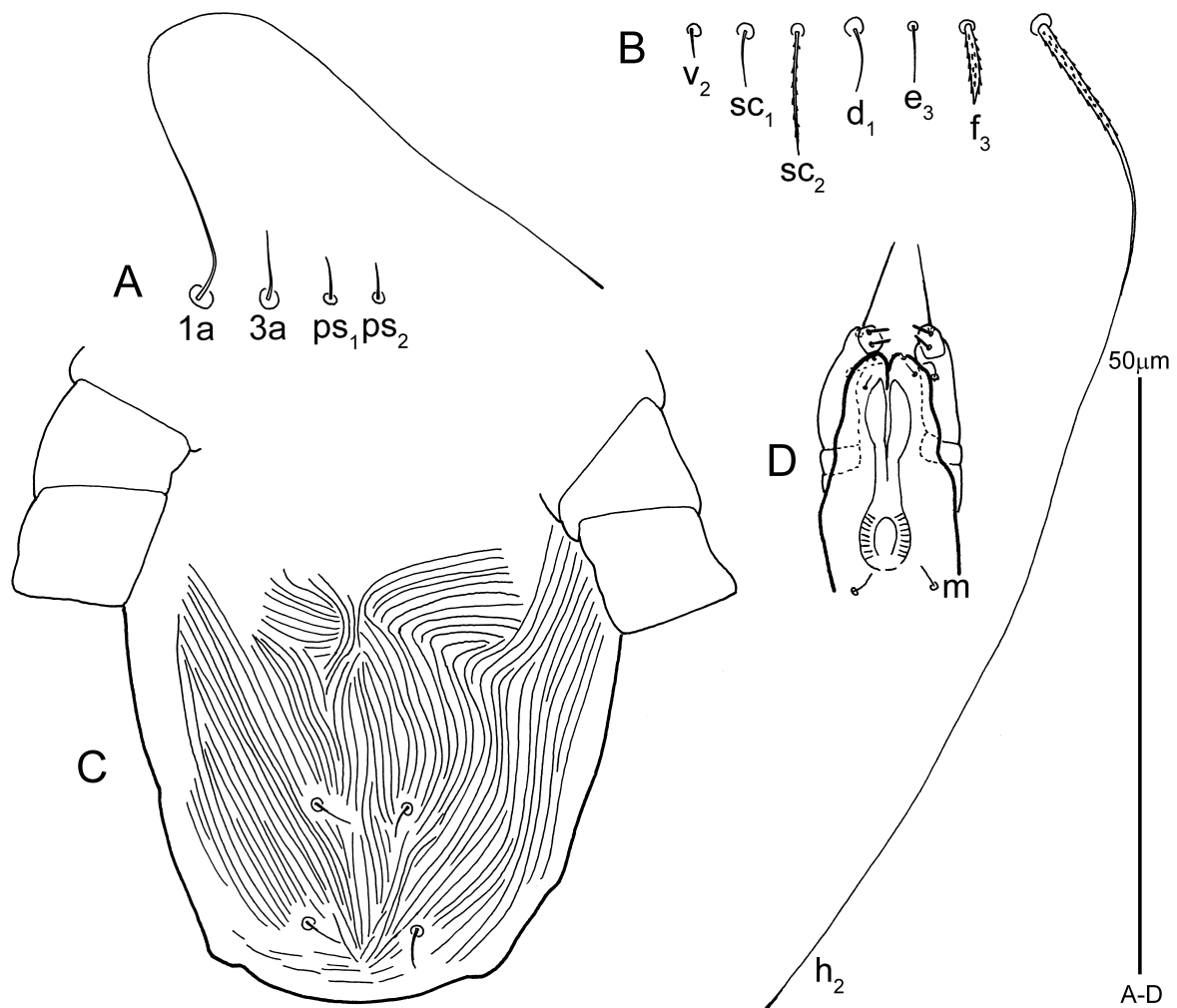


FIGURE 11. *Prolixus meyerae* sp. nov. (protonymph). A, dorsal setae; B, ventral setae; C, posterior venter; D, ventral aspect of distal infracapitulum.

**Legs.** (Fig. 12) Lengths of legs I–IV: 53–55, 43–44, 38–40, 36–38. Chaetotaxy: coxae 2-1-1-0; trochanters 0-0-1-0; femora 3-3-1-1; genua 1-1-0-0, tibiae 5-5-3-3, tarsi  $7+\omega-7+\omega-4-3$ . Most dorsal and lateral setae on trochanter III, femora I–II, genua I–II and tibiae lanceolate and barbed. Dorsal setae *d* on femora III–IV short, rod-shaped and lateral setae *l'* on tibiae I–II setiform. Ventral setae on femora I–II and tibiae setiform, except *bv''* on femora I pectinate, and *bv''* on femora II lanceolate, barbed. Setae *ft'* on tarsi I–IV flagelliform; unguinal setae *u* and tectal setae *tc* setiform. Lengths of solenidia: ta I  $\omega''$  3, ta II  $\omega''$  3. Claws and empodium pad-like with row of paired tenent hairs.

**Larva** (Figs. 13–15; n=5)

**Gnathosoma.** (Figs. 13B, 14C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta *m* setiform,  $m=3$ ,  $m-m=7-8$ . Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 1–2.

**Dorsal idiosoma.** (Figs. 13A, 14A) 200–260 long, 45–57 wide. Body elongate. PRODORSUM with mostly longitudinal striae, with oblique to transverse striae posteriorly; bearing 3 pairs of setae ( $v_2$ ,  $sc_1$  and  $sc_2$ ); setae  $v_2$  and  $sc_1$  minute, smooth; setae  $sc_2$  smooth, setiform, about twice as long as  $sc_1$ . Setal lengths:  $v_2$  2,  $sc_1$  3,  $sc_2$  6–7; distances:  $v_2-v_2$  16–18,  $v_2-sc_1$  27–32,  $sc_1-sc_1$  34–38,  $sc_1-sc_2$  22–28,  $sc_2-sc_2$  50–56. OPISTHOSOMA similar to protonymph with strong corrugated transverse striations between  $sc_2$  and  $d_1$ , and longitudinal striae posterior to  $d_1$ , with same setae as adults. Setae  $c_3$ ,  $d_3$ ,  $d_1$  and  $e_1$  minute, smooth; setae  $e_3$ ,  $f_3$  and  $h_1$  barbed, and  $h_2$  elongate, ending in minute club. Lengths:  $d_1$  4–5,  $e_1$  3,  $c_3$  1–2,  $d_3$  1–2,  $e_3$  2–3,  $f_3$  3–5,  $h_2$  64–98,  $h_1$  3; distances:  $d_1-d_1$  10–15,  $e_1-e_1$  7–10,  $c_3-c_3$  50–52,  $d_3-d_3$  35–39,  $d_3-e_3$  25–30,  $e_3-e_3$  24–30,  $e_3-f_3$  5–6,  $f_3-f_3$  21–24,  $f_3-h_2$  5–7,  $h_2-h_2$  14–17,  $h_2-h_1$  3–4,  $h_1-h_1$  7–11.

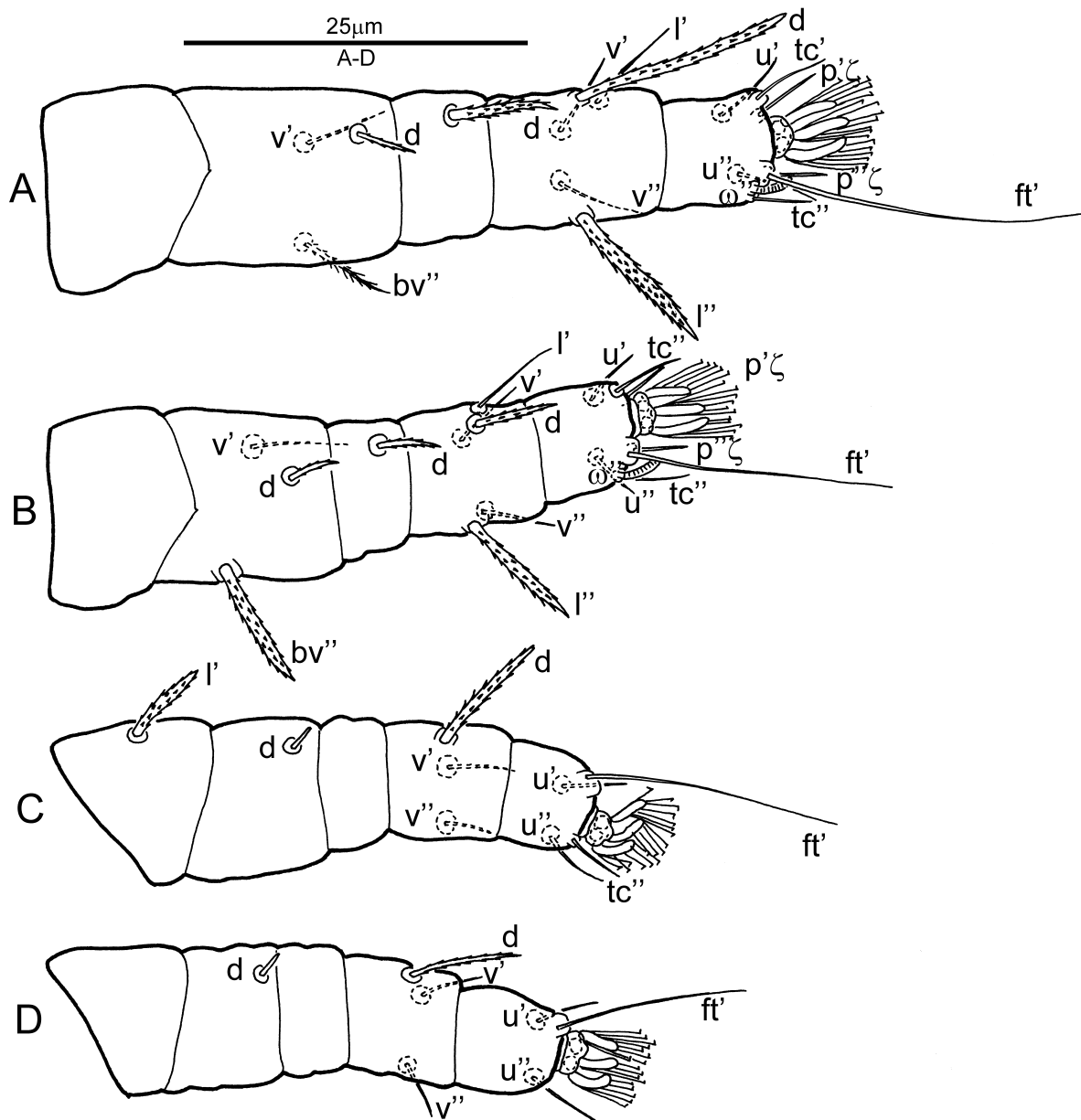


FIGURE 12. *Prolixus meyerae* sp. nov. (protonymph, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

**Venter.** (Figs. 13B, 14B, D) Similar to protonymph. Setae *1a* flagelliform, *1b* and *3a* setiform. Lengths: *1a* 63–71, *1b* 5–6, *3a* 6–7. Distances: *1a*–*1a* 9–10, *3a*–*3a* 7–10. Posterior opisthosoma with 2 pairs of pseudanal setae (*ps*<sub>1</sub> and *ps*<sub>2</sub>), setiform and subequal in length; aggenital and genital setae absent. Setal lengths: *ps*<sub>1</sub> 2–3, *ps*<sub>2</sub> 2–3. Distances: *ps*<sub>1</sub>–*ps*<sub>2</sub> 5.

**Legs.** (Fig. 15) Lengths of legs I–III: 41–45, 37–39, 37–39. Chaetotaxy: coxae 1-0-0; trochanters 0-0-0; femora 3-3-1; genua 1-1-0, tibiae 5-5-3, tarsi 5+ $\omega$ -5+ $\omega$ -3. Most dorsal and lateral setae on femora I–II, genua I–II and tibiae lanceolate and barbed; dorsal setae *d* on femora III smooth, setiform, lateral setae *l'* on tibiae smooth, setiform. Ventral setae on femora and tibiae setiform; Setae *ft'* on tarsi I–III flagelliform; unguinal setae *u* smooth, setiform. Lengths of solenidia: ta I  $\omega''$  2, ta II  $\omega''$  2. Claws and empodium pad-like with row of paired tenent hairs.

**Etymology.** The species is named after Magdalena K.P Smith Meyer, who is a distinguished acarologist and has made significant contributions to the systematics and biology of the Tenuipalpidae.

**Remarks.** This species of flat mite is found living in the tight grooves along the leaf blades of the host plants. They have a greenish-yellow body, which looks translucent and glossy, and is covered by series of minute black spots; legs I–II are obviously orange, and legs III–IV are pale orange; the eyes are red (Fig. 16).

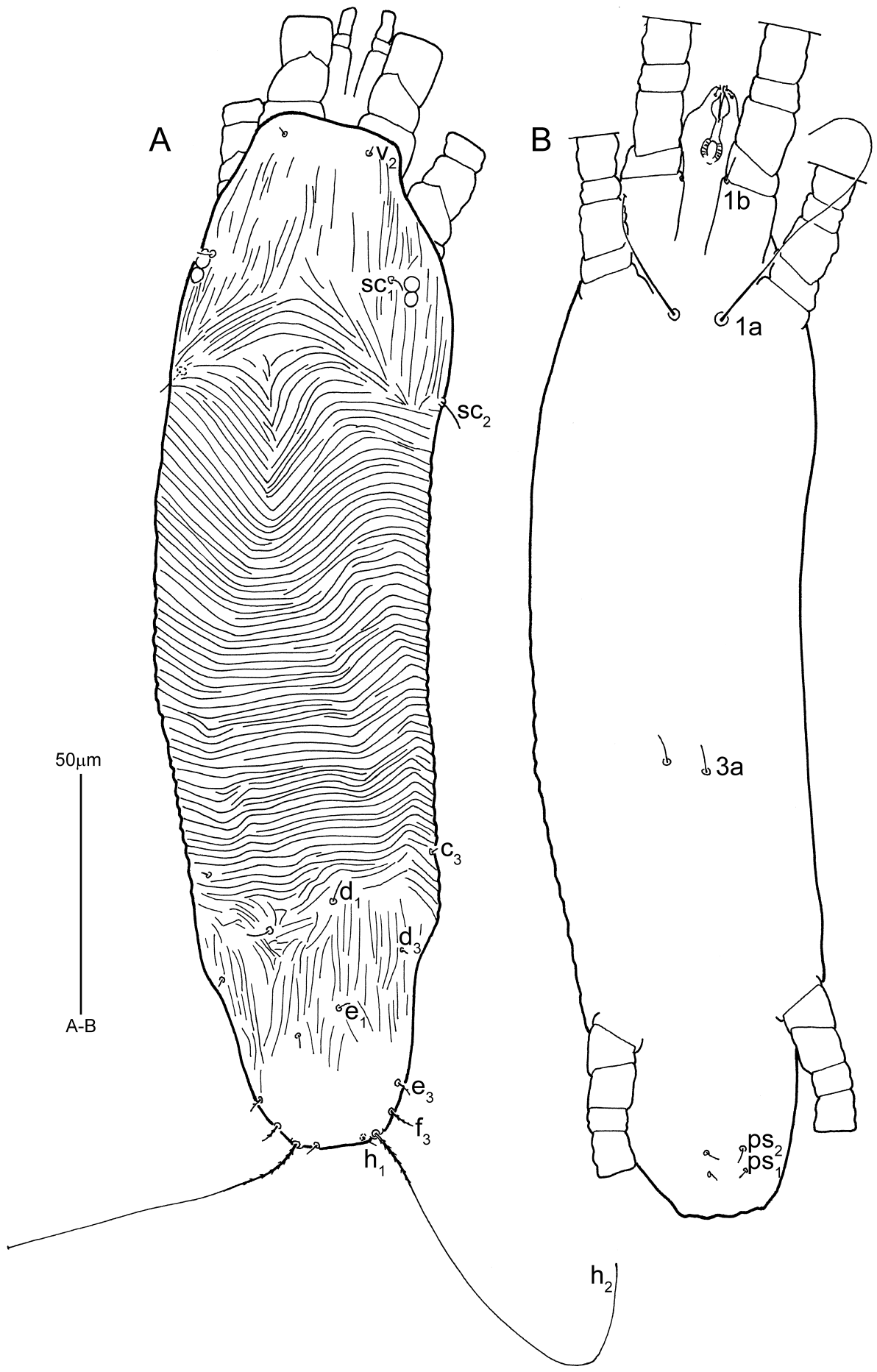


FIGURE 13. *Prolixus meyerae* sp. nov. (larva). A, dorsal view of idiosoma; B, ventral view of idiosoma.

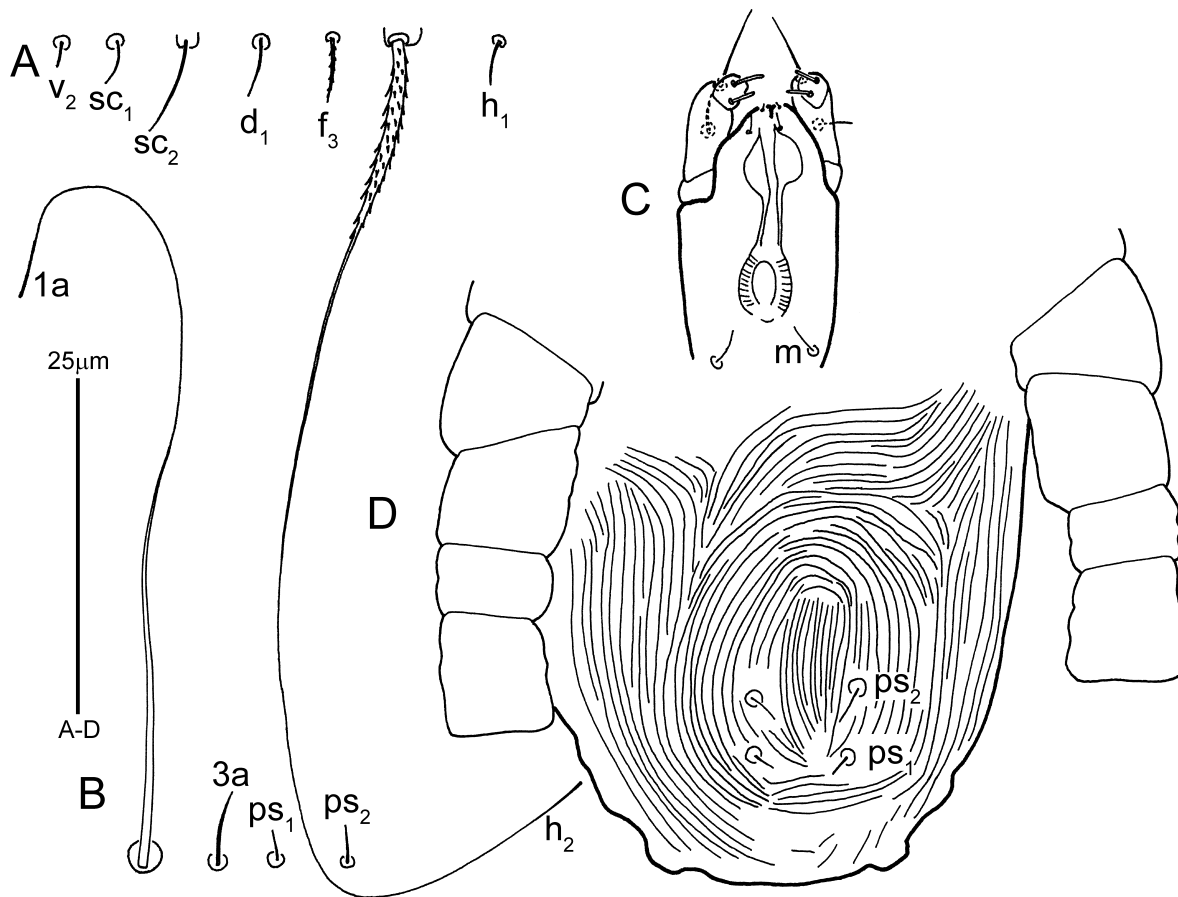


FIGURE 14. *Prolixus meyerae* sp. nov. (larva). A, dorsal setae; B, ventral setae; C, ventral aspect of distal infracapitulum; D, posterior venter.

The ontogeny of *Prolixus* was reported by Beard *et al.* (2005) and Beard & Ochoa (2011). Setae *1a*, *3a*, *ps*<sub>1</sub> and *ps*<sub>2</sub> are present from the larval stage; *ag*, if present, appear in protonymph; *4a*<sub>1</sub> and *g*<sub>1</sub> appear in deutonymph; *4a*<sub>2</sub> and *g*<sub>2</sub> are added in adult.

The changes in the chaetotaxy of leg segments of three species of *Prolixus* are summarized in Table 1. Larvae of all three species of *Prolixus* have nearly identical leg setal complements, with exception that *P. corruginus* lacks seta *d* on genu II and *P. meyerae* lacks seta *ev'* on femora III and IV. None of the above three species add any setae to the tibiae throughout development. All *Prolixus* species add tectal setae to tarsi I–III in the protonymph (ta IV in deutonymph): tectal pair is added in *P. forsteri*; only *tc''* is added in *P. corruginus* and *P. meyerae*. Other differences include: *P. meyerae* adds *l''* to both genu I and genu II in deutonymph, *P. corruginus* adds *l''* to genu I delayed until the adult and to genu II only in male, while *P. forsteri* adds *l''* to genu I only in male and to genu II in deutonymph; *P. forsteri* adds *l'* to both femur I and femur II in deutonymph; while while *P. corruginus* adds *l'* to femur I delayed to the adult and to femur II only in the male. No setae are added to the femora in *P. meyerae* throughout development.

#### Key to species of *Prolixus* (based on adult females)

1. Dorsal opisthosomal setae *f*<sub>2</sub> present; aggenital setae *ag* present; tarsi 7+ $\omega$ -7+ $\omega$ -5-5 . . . . . *P. forsteri* Beard, Fan & Walter
- Dorsal opisthosomal setae *f*<sub>2</sub> absent; aggenital setae *ag* absent; tarsi 7+ $\omega$ -7+ $\omega$ -4-4 . . . . . 2
2. Prodorsal setae *sc*<sub>1</sub> barbed, as long as *sc*<sub>2</sub>; ventral setae *1c*, *3b* and *4b* absent; trochanters 0-0-0-0; femora 4-3-2-2 (fe I with setae *d*, *l'*, *v'*, *bv''* present; fe III–IV with setae *d*, *ev'* present); genera 2-1-0-0 (ge II with seta *d* present; *l''* absent) . . . . . *P. corruginus* Beard, Fan & Walter
- Prodorsal setae *sc*<sub>1</sub> setiform, *sc*<sub>2</sub> about five times as long as *sc*<sub>1</sub>; ventral setae *1c*, *3b* and *4b* present; trochanters 0-0-1-0 (*l'* present on tr III); femora 3-3-1-1 (fe I with *d*, *v'*, *bv''* present; *l'* absent; fe III–IV with *d* present; *ev'* absent); genera 2-2-0-0 (ge II with *d*, *l''* present) . . . . . *P. meyerae* sp. nov.



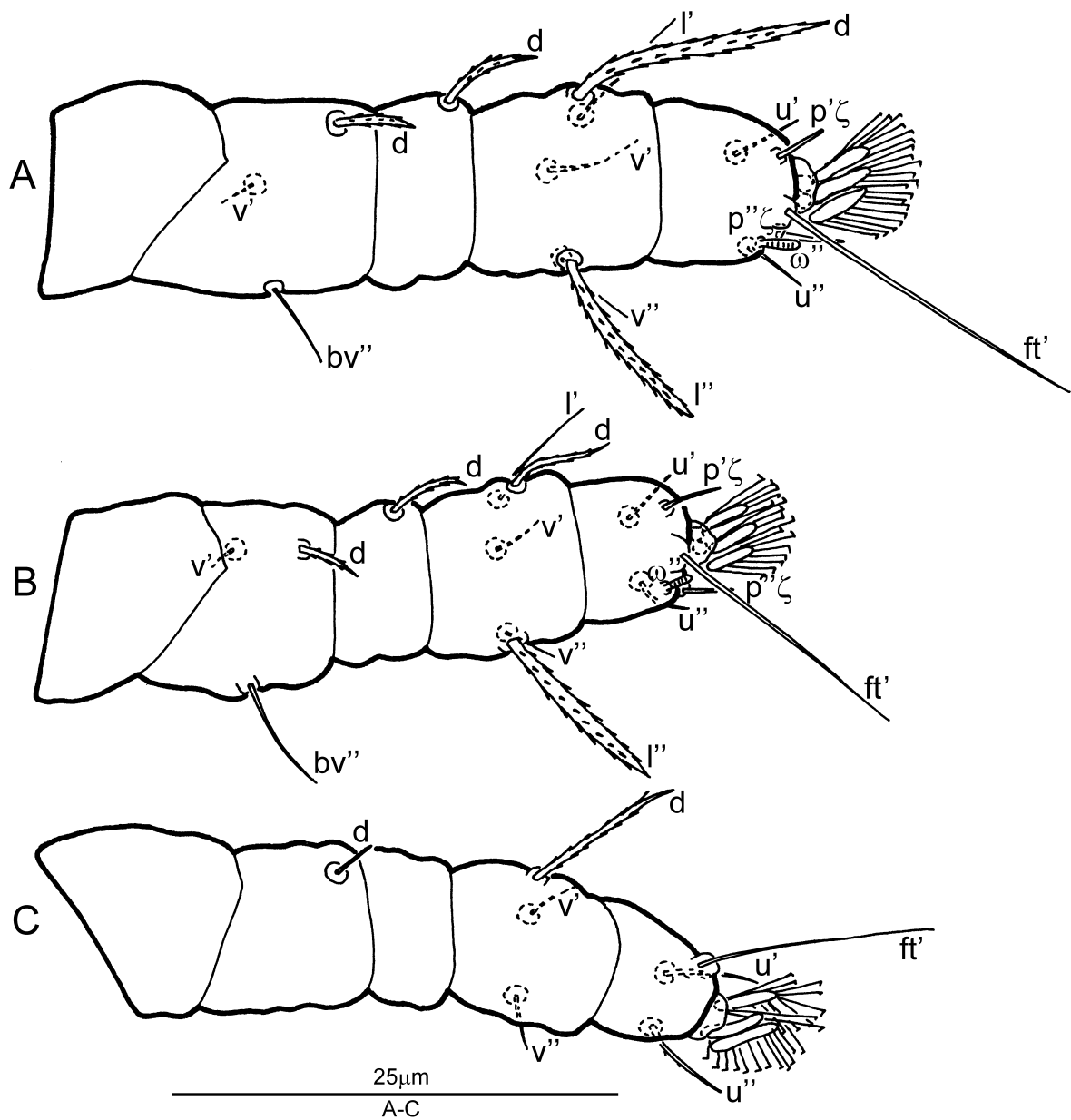


FIGURE 15. *Prolixus meyerae* sp. nov. (larva, right side legs). A, leg I; B, leg II; C, leg III.

TABLE 1. Ontogeny of leg chaetotaxy in *P. corruginus* (Pc), *P. forsteri* (Pf) and *P. meyerae* (Pm). Setae are indicated where they are first added. Setae in parentheses represent pairs. Hyphen indicates no additions.

	Coxae	Trochanters	Femora	Genua	Tibiae	Tarsi
Leg I						
Larva—Pc	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Pf	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Pm	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Protonymph—Pc	-	-	-	-	-	<i>(tc)</i>
Pf	-	-	-	-	-	<i>(tc)</i>
Pm	<i>lc</i>	-	-	-	-	<i>(tc)</i>
Deutonymph—Pc						
Pf	-	<i>v'</i>	<i>l'</i>	-	-	-
Pm	-	-	-	<i>l''</i>	-	-

.....continued on the next page

**TABLE 1** (continued)

	Coxae	Trochanters	Femora	Genua	Tibiae	Tarsi
Female—Pc	-	-	<i>l'</i>	<i>l''</i>	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	<i>v'</i>	<i>l'</i>	<i>l''</i>	-	<i>o'</i>
Pf	-	-	-	<i>l''</i>	-	<i>o'</i>
Pm	-	-	-	-	-	<i>o'</i>
Leg II						
Larva—Pc	-	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', o''</i>
Pf	-	-	<i>d, v', bv''</i>	-	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', o''</i>
Pm	-	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', o''</i>
Protonymph—Pc	<i>2c</i>	-	-	-	-	<i>(tc)</i>
Pf	<i>2c</i>	-	-	-	-	<i>(tc)</i>
Pm	<i>2c</i>	-	-	-	-	<i>(tc)</i>
Deutonymph—Pc	<i>2b</i>	-	-	-	-	-
Pf	<i>2b</i>	-	<i>l'</i>	<i>l''</i>	-	-
Pm	<i>2b</i>	-	-	<i>l''</i>	-	-
Female—Pc	-	-	-	-	-	-
Pf	-	<i>v'</i>	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	<i>v'</i>	<i>l'</i>	<i>l''</i>	-	<i>o'</i>
Pf	-	<i>v'</i>	-	<i>l'</i>	-	<i>o'</i>
Pm	-	-	-	-	-	<i>o'</i>
Leg III						
Larva—Pc	-	-	<i>d, ev'</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Pf	-	-	<i>d, ev'</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Pm	-	-	<i>d</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Protonymph—Pc	-	-	-	-	-	<i>tc''</i>
Pf	<i>3b</i>	<i>l'</i>	-	-	-	<i>(tc)</i>
Pm	<i>3b</i>	<i>l'</i>	-	-	-	<i>tc''</i>
Deutonymph—Pc	-	-	-	-	-	-
Pf	-	<i>v'</i>	-	-	-	-
Pm	-	-	-	-	-	-
Female—Pc	-	-	-	-	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	-	-	-	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Leg IV						
Protonymph—Pc	-	-	<i>d, ev'</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Pf	-	-	<i>d, ev'</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Pm	-	-	<i>d</i>	-	<i>d, (v)</i>	<i>(u), ft'</i>
Deutonymph—Pc	-	-	-	-	-	<i>tc''</i>
Pf	<i>4b</i>	-	-	-	-	<i>(tc)</i>
Pm	<i>4b</i>	-	-	-	-	<i>tc''</i>
Female—Pc	-	-	-	-	-	-
Pf	-	<i>v'</i>	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	-	-	-	-	-
Pf	-	<i>v'</i>	-	-	-	-
Pm	-	-	-	-	-	-

\* Leg IV absent in larva.



A Female



B Male



C Deutonymph



D Protonymph



E Larva

FIGURE 16. *Prolixus meyerae* sp. nov. (dorsal view of idiosoma). A, female; B, male; C, deutonymph; D, protonymph; E, larva.

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