

Redescription of *Bryobia pritchardi* Rimando, 1962 (Acari: Tetranychidae), with an ontogeny of chaetotaxy

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Research article

ABSTRACT

Bryobia pritchardi Rimando 1962, collected from *Drymaria cordata* in the Hainan province of China, is redescribed with a detailed illustration and description of all life stages. Special attention is given to ontogenetic changes, especially in leg setae, as well as intraspecific variation and asymmetry of these setae.

Keywords *Bryobia*; redescription; taxonomy; morphology; ontogenetic changes

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Introduction

The subfamily Bryobiinae usually identified by their plesiotypic features, such as: the empodium bearing tenent hairs; the lack of silk production; the position of the duplex setae at the apex of the tarsus; declivate tip of the tarsus; three pairs of pseudanal setae usually present; and four pairs of propodosomal setae often present (Lindquist 1985). Numerous Bryobiinae taxa add more whorls of leg setae during ontogeny, a feature seen in no other Tetranychoida (Lindquist 1985).

Bryobia is placed within the tribe Bryobiini, which is defined by its uncinat claws. The genus *Bryobia* is the largest genus of Bryobiinae and contains several species of significant economic importance in many parts of world (Hatzinikolis & Emmanouel 1991), it is distinctive by the following features: (1) Four pairs of propodosomal setae present, the anterior two pairs of which (v1, v2) are usually located on prominent projections over the gnathosoma; (2) the usual 12 pairs of dorsal hysterosomal setae; and (3) empodia II-IV with more than one pair of tenent hairs (Gonzalez 1977).

A total of 137 species of *Bryobia* are described, 19 of them from China (Migeon & Dorkeld 2006–2017; Hong *et al.* 2010; Hu & Chen 1993; He & Tan 1993; Wang & Cui 1991; Wang 1985, 1981; Wang & Zhang 1984; Ma & Yuan 1984, 1981, 1980). Beyond these descriptions, knowledge of the *Bryobia* mite fauna in China is relatively poor, but *Bryobia pritchardi* Rimando 1962 is common nationwide and in the east-Asian region. *Bryobia pritchardi*, was erected by Rimando in 1962 from *Paederia foetida* (Rubiaceae) in the Philippines; Ehara (1969) and Tseng (1990) collected it in Taiwan, from *Paederia scandens*; Wang (1981) and Ma *et al.* (1984) reported it from Hainan Island, China, collected from *P. foetida* (as *P. scandens*, a junior synonym) and *Acalypha hainanensis* (Euphorbiaceae); Ehara (1999) reported it in Japan (Shikoku and Kyushu islands) from *P. scandens* and *Cucumis melo* (Cucurbitaceae). *Bryobia pritchardi* is redescribed herein based on all immature stages collected from *Drymaria cordata* (Caryophyllaceae) in Hainan province, China. We also examined the type specimens of *B. pritchardi*, in order to compare the types and our specimens.

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Recently great importance has been attached to understanding the patterns of setal additions throughout ontogenetic development of the Tetranychoida (Khanjani *et al.* 2018; Seeman *et al.* 2017; Li *et al.* 2018, 2017; Xu *et al.* 2017; Yi *et al.* 2017, 2013; De Castro *et al.* 2015; Beard & Ochoa 2010; Beard & Walter 2010). There are few scholars who have paid attention to the ontogenetic patterns for species of *Bryobia*. Immature stages for some other species have been described, such as Auger & Migeon (2014), who noted the development of the prodorsal lobes during ontogeny and also provided leg setal counts. However, since the important work of Lindquist (1985), authors have provided full characteristic notations for a *Bryobia* sp. Until the important task of comparative homologization of leg setae is accomplished for the families of Tetranychoida as a group, a great deal of data of potential importance to the systematics and classification of these groups will remain masked. We herein examine setal variations of female leg I based on 25 specimens, and also discuss other intraspecific morphological variation.

Material and methods

The mite specimens were mounted in Hoyer's medium on slides and examined using a Nikon DS-Ri2 microscope with differential interference contrast. Line drawings were prepared with the aid of a drawing tube attached to the microscope. All measurements were taken with the software Leica Application Suite V 4.4 and are given in micrometers (μm). Setae were measured from the centre of the setal base to the tip of the seta; distances between setae were measured from the centre of one setal base to that of another. Legs were measured from the base of the trochanter to the distal end of tarsus (excluding pretarsus). Terminology follows that of Lindquist (1985).

Results

Family Tetranychidae Donnadieu, 1875

Subfamily Bryobiinae Berlese, 1913

Tribe Bryobiini Reck, 1952

Genus *Bryobia* Koch, 1836

Bryobia pritchardi Rimando, 1962: 9, Figs 3–4; Ehara 1969: 83, Figs 1–3; Wang 1981: 33, Fig. 19; Ma *et al.* 1984:103, Fig.8 (16); Tseng 1990: 15, Figs 28–32.

Bryobia pritchardi Rimando, 1962 (Figs. 1–28)

Material examined

Twenty-five females (slides NO. 1601090301–1601090325), seven males (1601090326–1601090332), one deutonymph (1601090333), eight protonymphs (1601090334–1601090341) and ten larvae (1601090342–1601090352), collected from *Drymaria cordata* in Hainan Xinlong Tropical Botanical Garden, Hainan province, P. R. China, 106°16'39"E, 19°54'12"N, elevation 71 m, on 9 Jan. 2016, by Juan Li. The specimens studied are deposited in Institute of Entomology, Guizhou University, P. R. China (GUGC). Holotype female, ex. *Paederia foetida*, from Lipa City, Batangas, Philippines, coll. L.C. Rimando, currently on loan to the Smithsonian in Washington D. C.

Diagnosis

With the generic characters and:

Female — Body subovate. Prodorsal setae each on four well-developed anterior lobes, of which inner row shares more or less triangular broad base and well separated distally, with obvious incision; dorsal transverse line reaching to the tops of the outer lobes and crossing or reaching up to the incision of inner lobes. The line joining tips of second pair of propodosomal

seta (v_2) located on the outer lobes generally passes slightly under the bases of the first pair (v_1). Dorsal setae spatulate to orbicular, rough and serrate. Stylophore longer than wide. Peritreme anastomosed distally in hook-like enlargement with a shallow incision. Ventral setae smooth and filiform with the exception of lanceolate and serrate $1c$ and $2b$; sacculus elongate, constricted medially and bulbous distally. Leg segment setal formula as follows: trochanters 1–1–1–1; femora 16–17–10–5–5; genua 8–5–6–6; tibiae 15 (1ϕ)–9–9–9; tarsi 19 ($5\omega+2dup$)–17 ($0\omega+1dup$)–15 (0ω)–14 (1ω).

Male — Prodorsal setae on weakly developed anterior lobes: inner lobes with large fused base, incision between median lobes wide and shallow; outer lobes on weak projectons. Leg segment setal formula as follows: trochanters 1–1–1–1; femora 16–17–10–5–5; genua 8–5–6–6; tibiae 15 (1ϕ)–9–9–9; tarsi 18($9\omega+2dup$)–16($0\omega+1dup$)–14 (1ω)–14 (1ω). Empodia I–IV same as that of females; shaft of aedeagus abruptly constricted towards its distal part, ending in needle-like round tip.

Redescription

Female (n=10)

Dorsum (Fig. 1; 5D; 24B–D; 25A, E; 26D; 28C) — Length of idiosoma 564–713 (including gnathosoma), 468–615 (excluding gnathosoma). Body oval, except for posterior edge of hysterosoma somewhat “W” shaped (Figs. 3E; 25B). Body striae fingerprint-like, mostly transverse, striae in depressed areas denser; integument also with several large irregular folds (Figs. 1A; 24B–D; 25A; 26D). Prodorsal setae on well-developed anterior lobes (Figs. 5D; 25E). Inner lobes sharing more or less triangular broad base and well separated distally, with obvious incision (incision length 18–21). Outer prodorsal lobes teat-like, 22–31 in length, not extending beyond base of inner lobes, incision between outer and median lobes deep and wide. Setae v_1 14–18, v_2 15–22, both spatulate and serrated (Figs. 1B, 5D). Dorsal setae spatulate to orbicular rough, serrate, with small bulge-like bases, subequal in length (Figs. 1B; 1C; 28C). Dorsocentral setae (c_1 , d_1 and e_1) short. Setal lengths: sc_1 10–17, sc_2 8–18, c_1 7–13, c_2 8–12, c_3 10–13, d_1 9–12, d_2 9–13, d_3 9–12, e_1 9–13, e_2 10–12, e_3 9–12, f_1 10–14, f_2 12–15, h_1 10–14. Distances between setal bases: v_1 – v_1 13–26, v_2 – v_2 100–128, c_1 – c_1 63–75, d_1 – d_1 65–89, e_1 – e_1 60–83, c_1 – d_1 95–123, d_1 – e_1 80–97. Sacral setae (f_1 and f_2) contiguous and posited posteriorly.

Venter (Figs. 2; 3B, D; 24A; 26C) — Ventral setae smooth and filiform with the exception of lanceolate and serrated $1c$ and $2b$. Anterior intercoxal region without striae (irregular folds occasionally present); lateral striae on hysterosoma U-shaped, sparse. Area immediately anterior to genital flap with irregular longitudinal striae, pregenital setae (ag) 21–28 long. Genital setae (g_1 – g_2) 30–37 long. Pseudanal setae (ps_1 – ps_3) 28–31 long. Ventral opisthonotal setae (h_2 – h_3) 19–24 long (Figs. 24A; 26C). Spermatheca with funnel-shaped sacculus (Figs. 3B, 3D). Length of other ventral setae: $1a$ 31–34, $1b$ 38–49, $1c$ 27–38, $2b$ 12–28, $3a$ 24–35, $3b$ 12–18, $4a$ 24–32, $4b$ 10–15. Distances between setae: $1a$ – $1a$ 60–70, $3a$ – $3a$ 81–91, $4a$ – $4a$ 63–113, ag – ag 61–75, g_1 – g_1 26–37, g_2 – g_2 67–103.

Gnathosoma (Figs. 3A, C; 25C–D; 28A–B) — Stylophore longer than wide. Peritreme anastomosed and enlarged distally with a shallow incision. Tracheal system variation as shown in Fig. 4D.

All tactile setae, except for setae $dPFe$, on palp slender and bare. Setae $dPFe$ orbicular and serrate, long 14–17. Seta $l'PGe$ 15–22 in length. Palptibia with a bidentate ‘claw’ and three setae. Seta $l'PTi$ long 5–7, located near base of tibial claw. Seta $dPTi$ 12–15, about twice as long as seta $l'PTi$ 5–7. Palptarsus elongated, with three tactile setae (a , b , c), three eupathidia and one solenidion (Fig. 3C). Eupathidia ($ul'\zeta$, $ul''\zeta$) and solenidion (ω) slightly shorter than terminal sensillum ($su\zeta$), (Figs. 25C–D; 28A–B): ω 5–7, $ul'\zeta$ 3–5, $ul''\zeta$ 3–5, $su\zeta$ 7–9, a 9–11, b 5–8, c 3–4.

Spermatheca (Figs. 3B, D) — Sacculus elongate, constricted medially and bulbous distally.

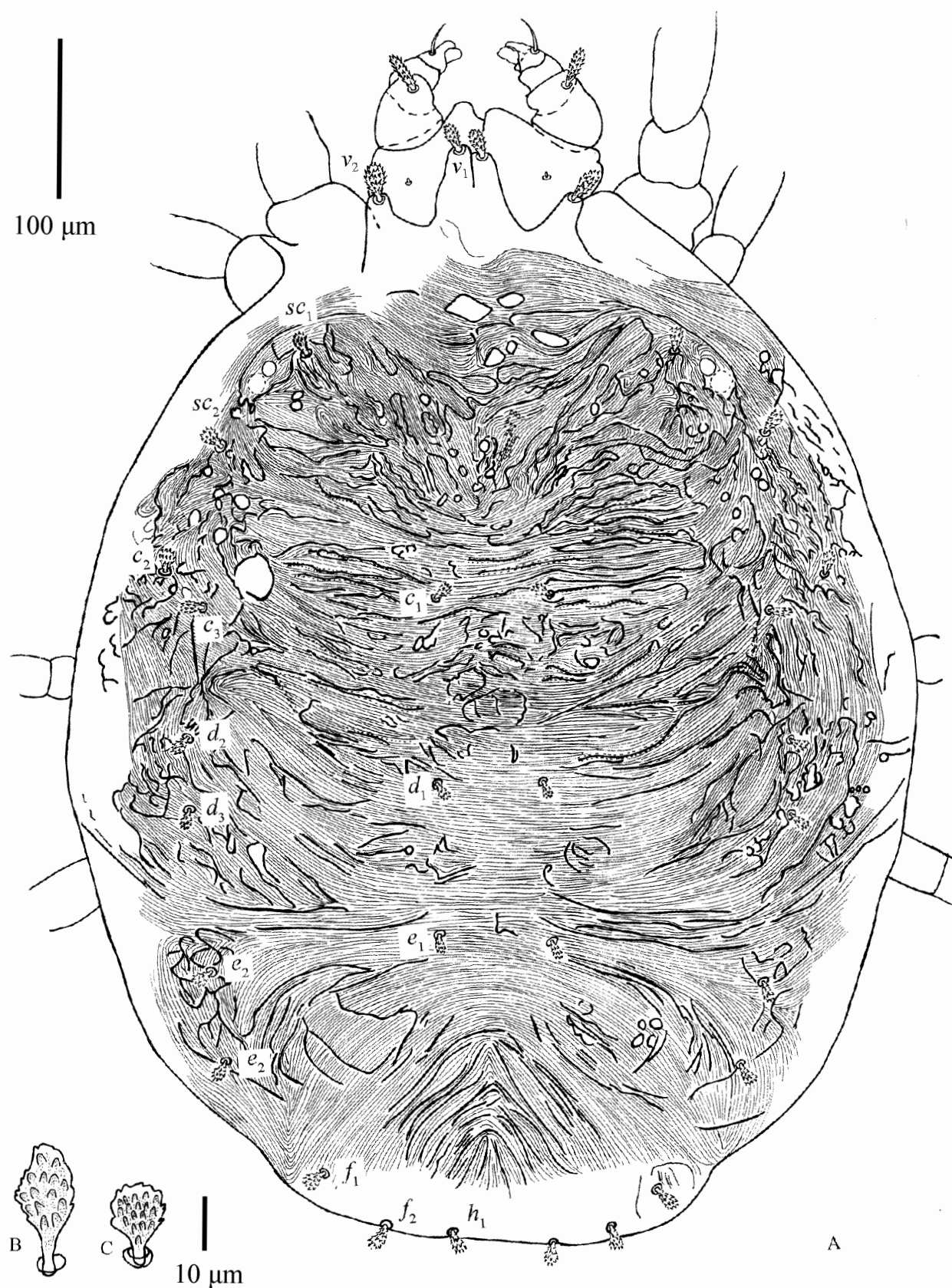


Figure 1 *Bryobia pritchardi*, female, A, dorsal idiosoma; B, seta v_2 ; C, seta sc_1 . Scale bars, A, 100 µm, B-C, 10 µm.

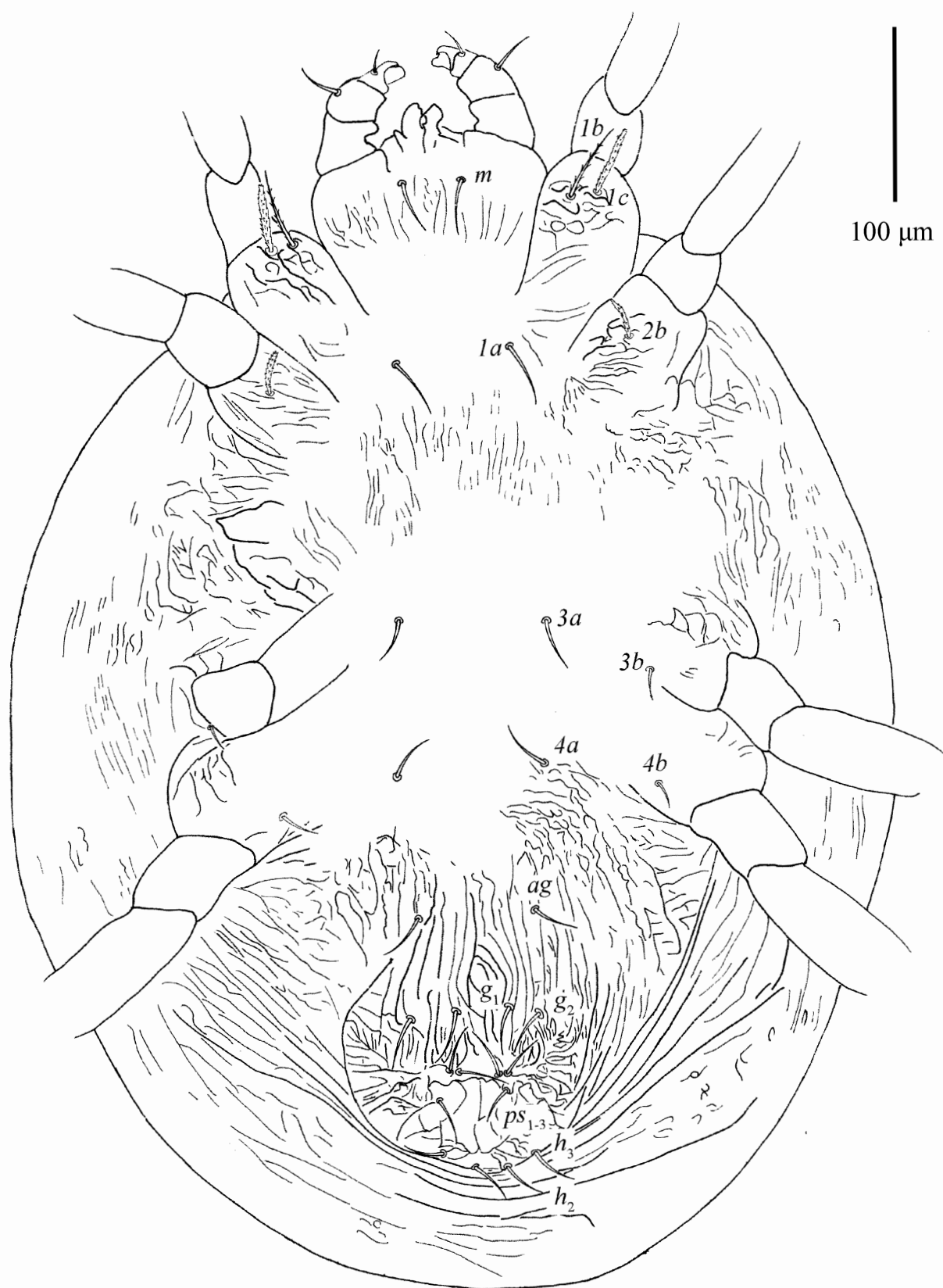


Figure 2 *Bryobia pritchardi*, female, ventral view. Scale bar 100 μm.

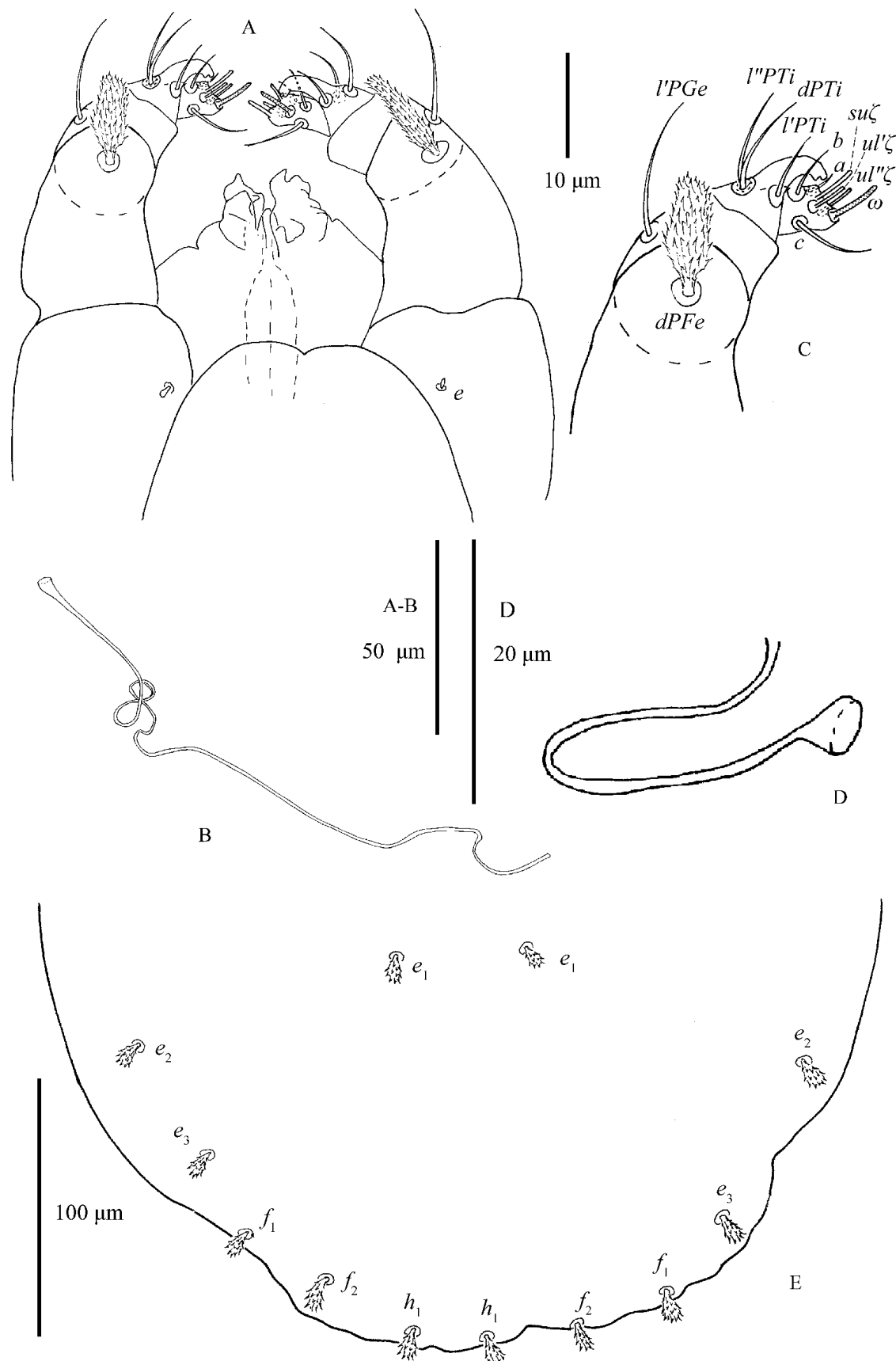


Figure 3 *Bryobia pritchardi*, female, A, gnathosoma, dorsal view; B, D, spermatheca; C palp; E, distal portion of dorsal hysterosoma. Scale bars, A–B, 50 μm, C, 10 μm, D, 20 μm, E, 100 μm.

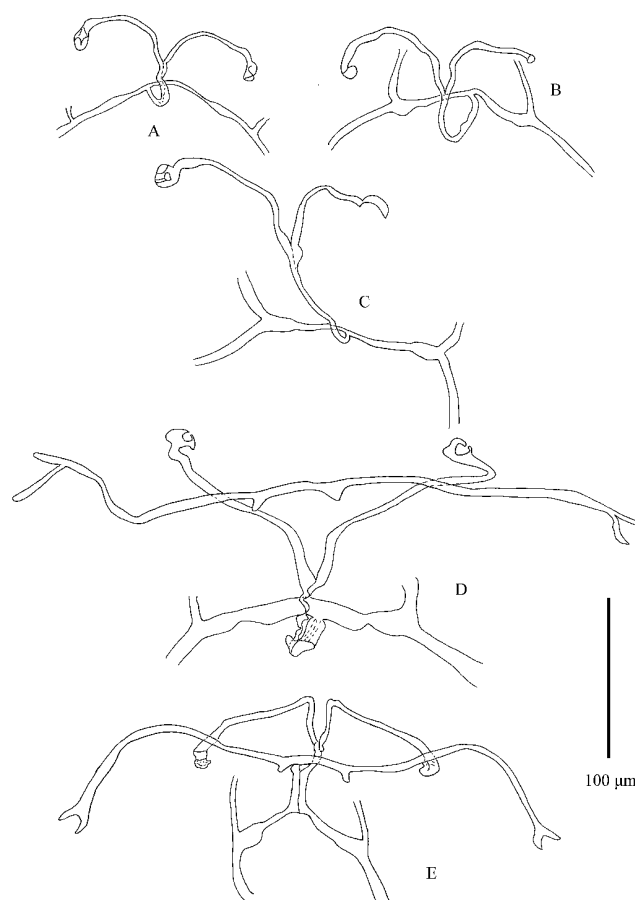


Figure 4 *Bryobia pritchardi*, system of tracheae, A, larva, B, protonymph, C, deutonymph, D, female, E, male. Scale bar 100 μ m.

Legs (Figs. 6–7) — Empodia I–IV bearing two rows of ventrally directed hairs. True claws I pad-like with three pairs of tenant hairs (Fig. 5F), claw II–IV uncinat with several pairs of hairs (Fig. 5G).

Tarsus I with two pairs of duplex setae distal and adjacent, proximal solenidion ω' 55–64, distal solenidia ω'' 62–82, $\omega'1$ 34–44, $\omega'2$ 26–35, $\omega'2$ 28–40, $\omega'3$ 23–42, $\omega'3$ 23–35 in length; tarsus II with one pair of duplex setae: ω' 29–40 in length. Tarsi III–IV without duplex setae and tarsus III without solenidia, tarsus IV with one solenidion $\omega'1$ 13–20.

All leg setae barbed (Figs. 6–7). Number of phaneres on legs I–IV (number of solenidia and eupathidia respectively shown in parentheses):

Trochanter	–	Femur	–	Genu	–	Tibia	–	Tarsus
leg I	–	1	–	16–17	–	8	–	15 (1) – 18 (7 ω +3)
leg II	–	1	–	10	–	5	–	9 – 15 (1 ω +3)
leg III	–	1	–	5	–	6	–	9 – 15 (0 ω +0)
leg IV	–	1	–	5	–	6	–	9 – 14 (1 ω +0)

One solenidion ϕ 17–24 on tibia I. Tibiae II–IV without solenidia. Lengths of legs (measured from trochanter to tarsus): leg I 609–667, leg II 342–379, leg III 326–411, leg IV 425–455.

Lengths of leg segments: trochanter I 40–52, femur I 204–228, genu I 90–106, tibia I 151–170,

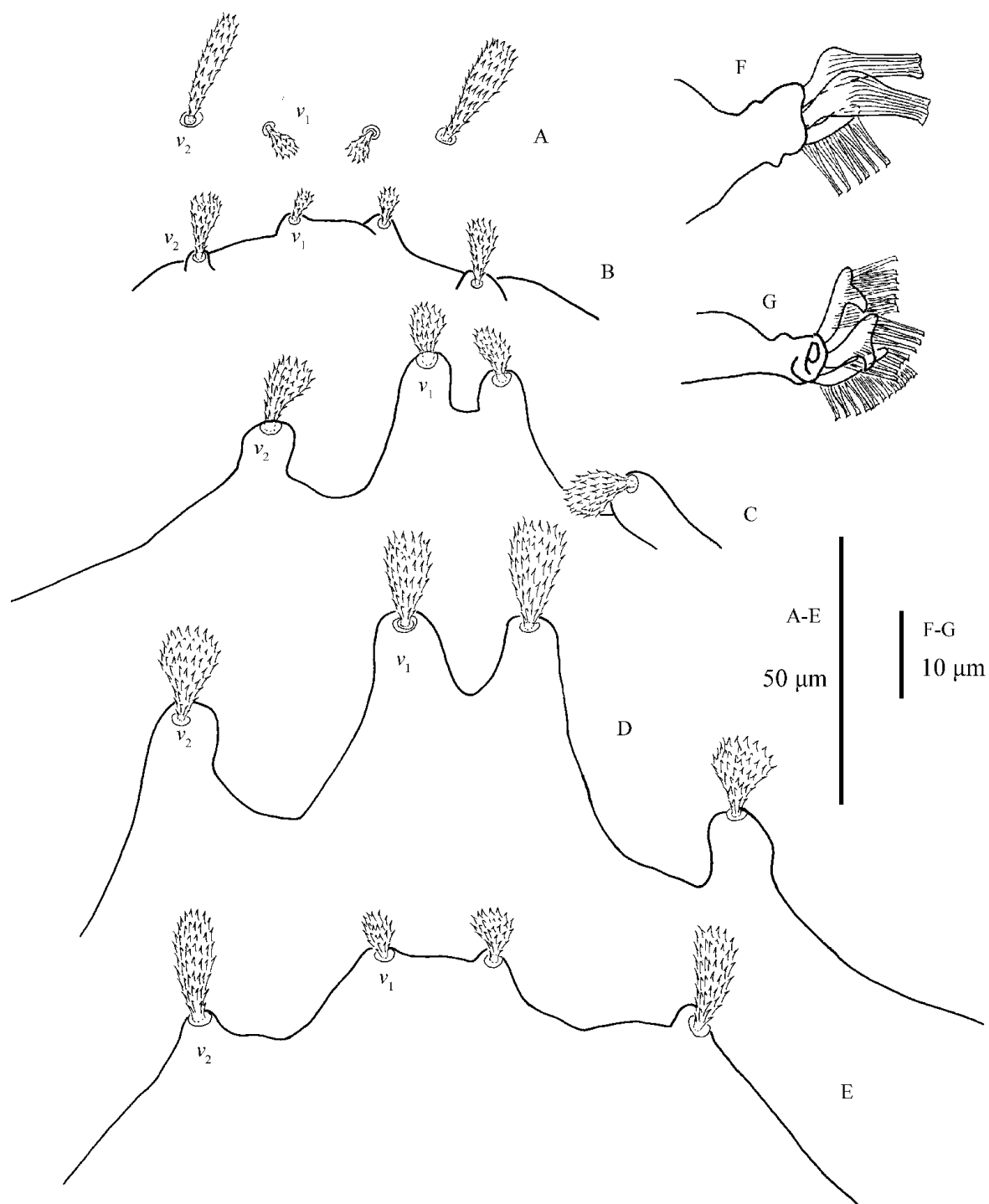
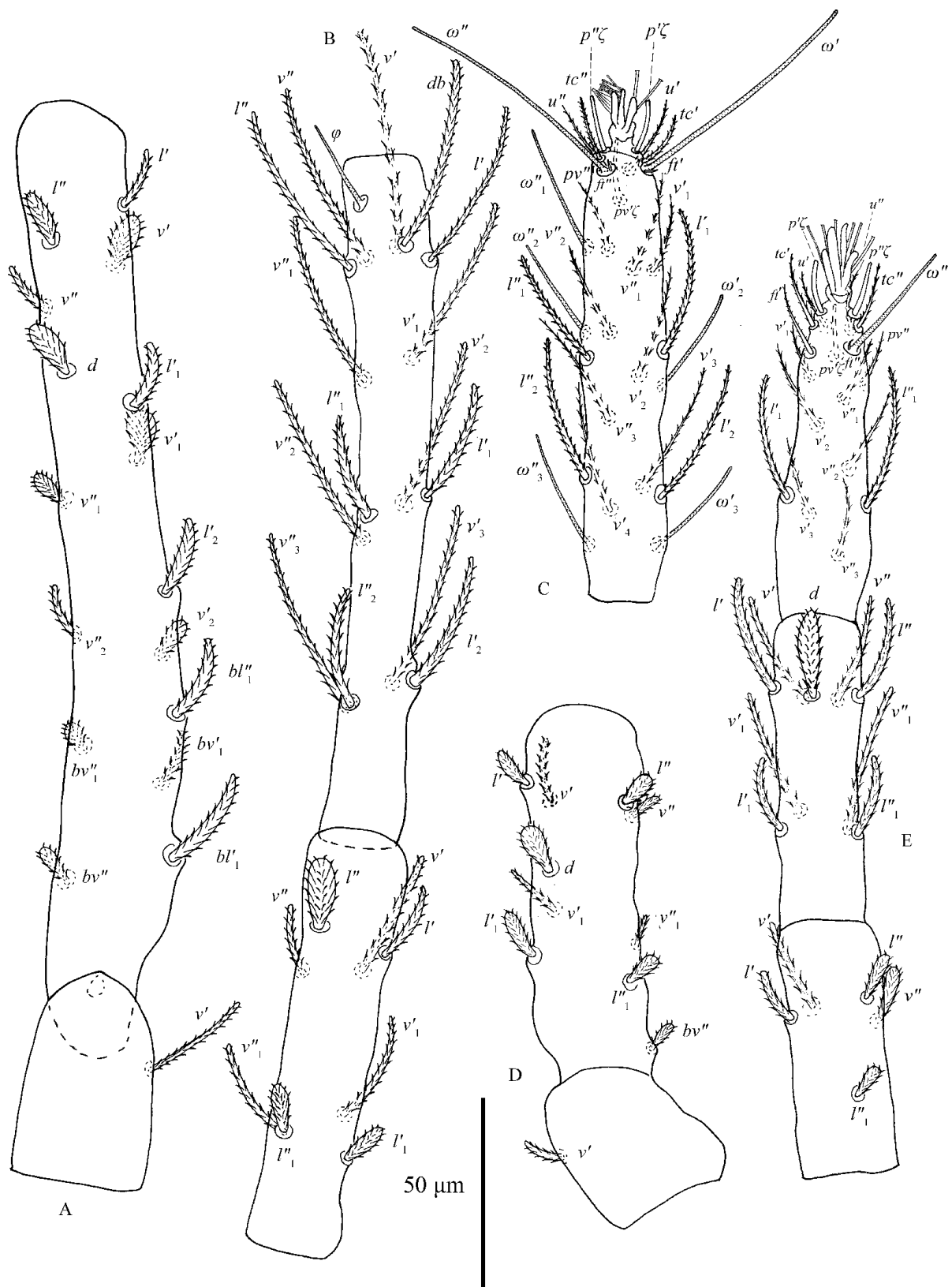


Figure 5 *Bryobia pritchardi*, A–E, propodosomal lobes, A, larva, B, protonymph, C, deutonymph, D, female, E, male; F–G, claw and empodium, F, claw and empodium I, G, claw and empodium II. Scale bars, A–E, 50 µm, F–G, 10 µm.



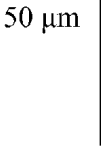


Figure 7 *Bryobia pritchardi*, female, A–B, legs III, D–E, leg IV; left side legs. Scale bar 50 μ m.

tarsus I 109–120; trochanter II 35–42, femur II 91–105, genu II 63–70, tibia II 72–81, tarsus II 76–84; trochanter III 39–54, femur III 80–109, genu III 58–74, tibia III 73–90, tarsus III 83–98; trochanter IV 41–54, femur IV 115–137, genu IV 70–88, tibia IV 88–100, tarsus IV 95–109.

Leg setation as shown in Figures 6–7. We examined 25 type specimens: no variation was found on the genu, tibia and trochanter. Anomalies on tarsus I: 2 specimens lack seta $v'4$; 2 specimens lack seta $l''2$, 1 specimen lacks solenidion $\omega'2$, 1 specimen without $\omega'3$, 1 specimen lacks $v''2$, $v''3$ and $v'4$, 1 specimen lacks setae $\omega'2$ and $l''2$; 1 specimen lacks setae $\omega'3$ and $v'4$. Anomalies on femur I: the setae of femur I vary in number and position: femur I with 15–17 setae, including nine “steady” setae (d , $v'-v''$, $l'-l''$, bv'' , $bv'1$, $bl'1-bl''1$) shown on deutonymph femur I, remaining setae ($l'1-l''1$, $l'2-l''2$, $v'1-v''1$, $v'2-v''2$) usually varying in number and position (Fig. 23; Table 3).

Male (n=7)

Dorsum (Fig. 8) — Length of idiosoma 390–502 (including gnathosoma), 308–410 (excluding gnathosoma). Prodorsum with 4 pairs of setae and with weakly developed anterior lobes: inner lobes with large fused base forming cone-shaped projection, incision between median lobes wide and shallow (Fig. 5E). Distance between first ($v1$) and second ($v2$) pair of propodosomal setae 20–34 and 58–97, respectively. Seta $v2$ 17–25 about three times as long as the seta $v1$ 7–12. Dorsal body setae spatulate to orbicular, rough, serrate, inserted on small bulge-like structures, subequal in length: $sc1$ 10–15, $sc2$ 10–15, $c1$ 8–13, $c2$ 9–15, $c3$ 7–11, $d1$ 7–15, $d2$ 7–15, $d3$ 8–14, $e1$ 6–11, $e2$ 8–14, $e3$ 7–14, $f1$ 8–12, $f2$ 8–11, $h1$ 9–13. Distances between setal bases: $v1-v1$ 20–34, $v2-v2$ 58–97, $c1-c1$ 33–52, $d1-d1$ 28–44, $e1-e1$ 34–59, $c1-d1$ 45–67, $d1-e1$ 49–67. Sacral setae ($f1$ and $f2$) in marginal position.

Venter (Fig. 9) — All ventral setae smooth, including $1c$ and $2b$. Striate sparse, irregularly transverse when present; area immediately anterior with few irregular striae, setae ag 14–22; genital and pseudanal setae ($ps1-5$), subequal in length 9–13, much shorter than those of female (Fig. 10B; 27A–C); ventral opisthosomal setae ($h2-3$) 5–8 long. Almost all ventral setae much shorter than those of female: $1a$ 29–35, $1b$ 33–42, $1c$ 31–35, $2b$ 17–26, $3a$ 19–27, $3b$ 13–20, $4a$ 23–29, $4b$ 16–27. Distances between setae: $1a-1a$ 39–55, $3a-3a$ 53–59, $4a-4a$ 37–48, $ag-ag$ 17–29.

Gnathosoma (Figs. 10A, C) — All tactile setae on palp slender, bare except setae $dPFe$ orbicular, serrate, length 14–17. Subcapitular seta m smooth, length 19–29, distance $m-m$ 18–27. Seta $l'PGe$ 20–24 in length. Palptibia with bidentate ‘claw’, similar to female. Seta $l'PTi$ length 14–23, seta $dPTi$ length 18–27, about twice as long as seta $l'PTi$, length 7–12. Palptarsus elongated, with three tactile setae (a , b , c), three eupathidia and one solenidion (Fig. 10C). Solenidion ω length 13–18, slightly thinner and longer than female’s. Eupathidia ($ul'\zeta$, $ul''\zeta$) slightly shorter than terminal sensillum ($su\zeta$): $ul'\zeta$ 5–9, $ul''\zeta$ 6–8, $su\zeta$ 8–15, a 10–15, b 6–11, c 12–22.

Aedeagus (Figs. 10D–E) — Shaft abruptly constricted towards distal part, ending in needle-like round tip.

Legs (Figs. 11–12) — Empodia I–IV similar to female (Figs. 10F–G).

All leg setae barbed (Figs. 11–12). Number of phaneres on legs I–IV (number of solenidia and eupathidia respectively shown in parentheses):

Trochanter – Femur – Genu – Tibia – Tarsus
leg I – 1 – 16–17 – 8 – 15 (1) – 17 (11 ω +3)
leg II – 1 – 11 – 5 – 9 – 14 (1 ω +3)
leg III – 1 – 6 – 6 – 9 – 14 (1 ω +0)
leg IV – 1 – 6 – 6 – 9 – 14 (1 ω +0)

Tarsus I: two pairs of duplex setae distal and adjacent, proximal solenidion $\omega'54$ –67, distal solenidia $\omega''61$ –74, $\omega''135$ –57, $\omega'143$ –63, $\omega'238$ –48, $\omega''234$ –57, $\omega'353$ –67, $\omega''342$ –63, $\omega'431$ –42, $\omega''442$ –60, $\omega'540$ –59 in length; tarsus II with one pair of duplex setae: $\omega'37$ –45

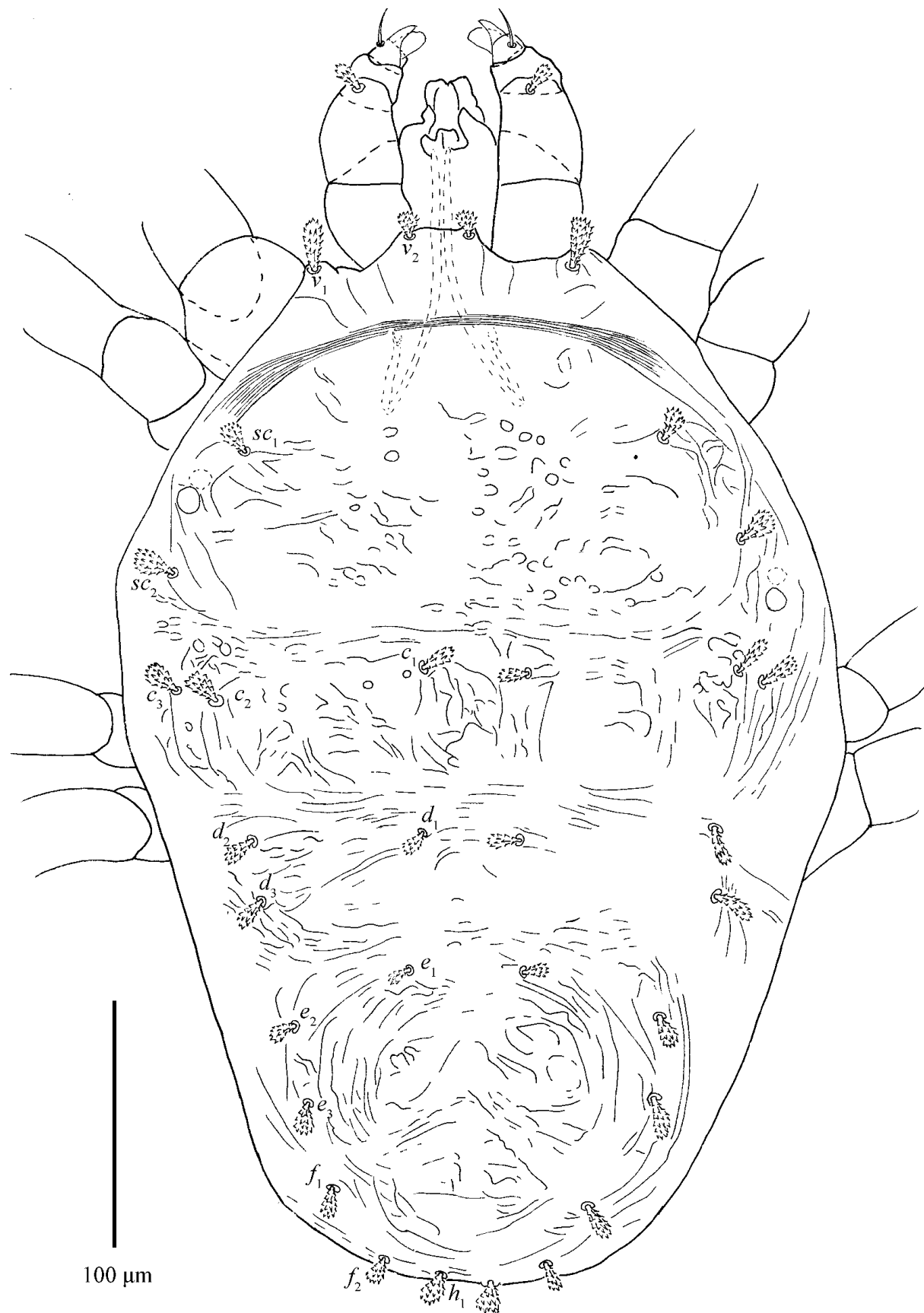


Figure 8 *Bryobia pritchardi*, adult male, dorsal idiosoma. Scale bar 100 μm.



Figure 9 *Bryobia pritchardi*, adult male, ventral view. Scale bar 100 μm.

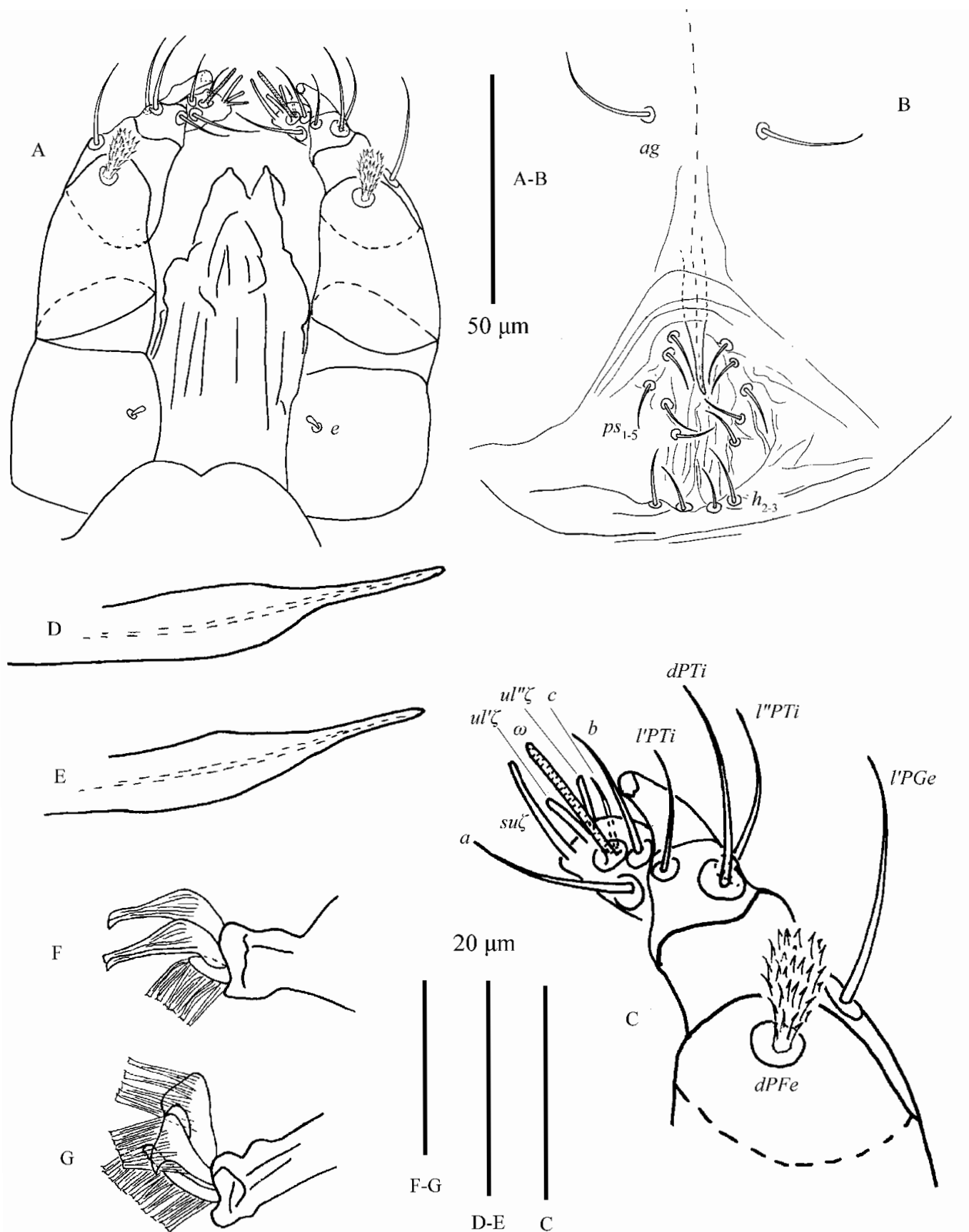


Figure 10 *Bryobia pritchardi*, adult male, A, gnathosoma, dorsal view; B, ventral view of genital region, C, palp, D-E, aedeagus, F, claw and empodium I, G, claw and empodium II. Scale bars, A-B, 50 μm , C-E, 20 μm , F-G 10 μm .

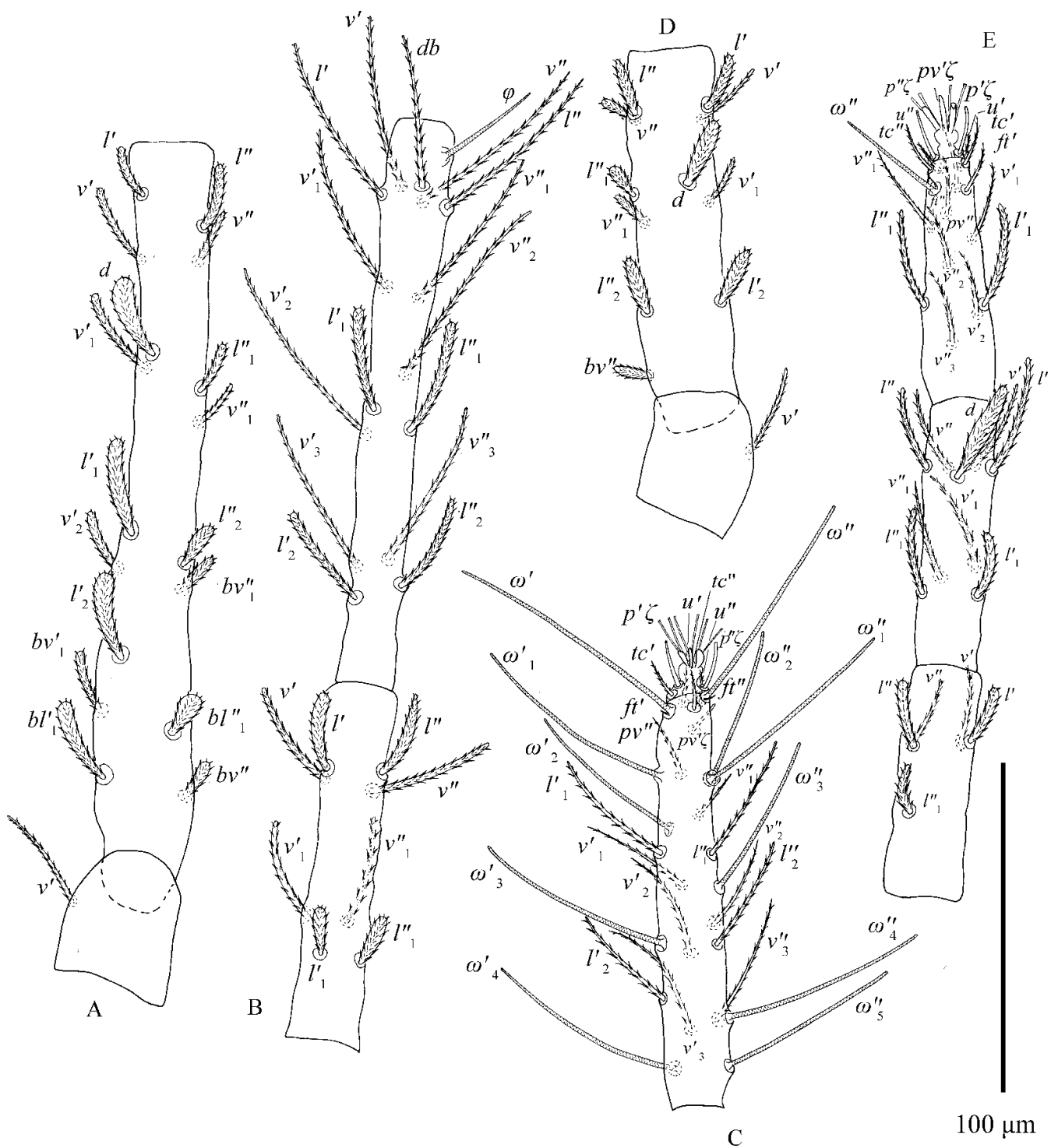


Figure 11 *Bryobia pritchardi*, male, A–C, legs I, right side leg; D–E, leg II, left side leg. Scale bar 100 μ m.

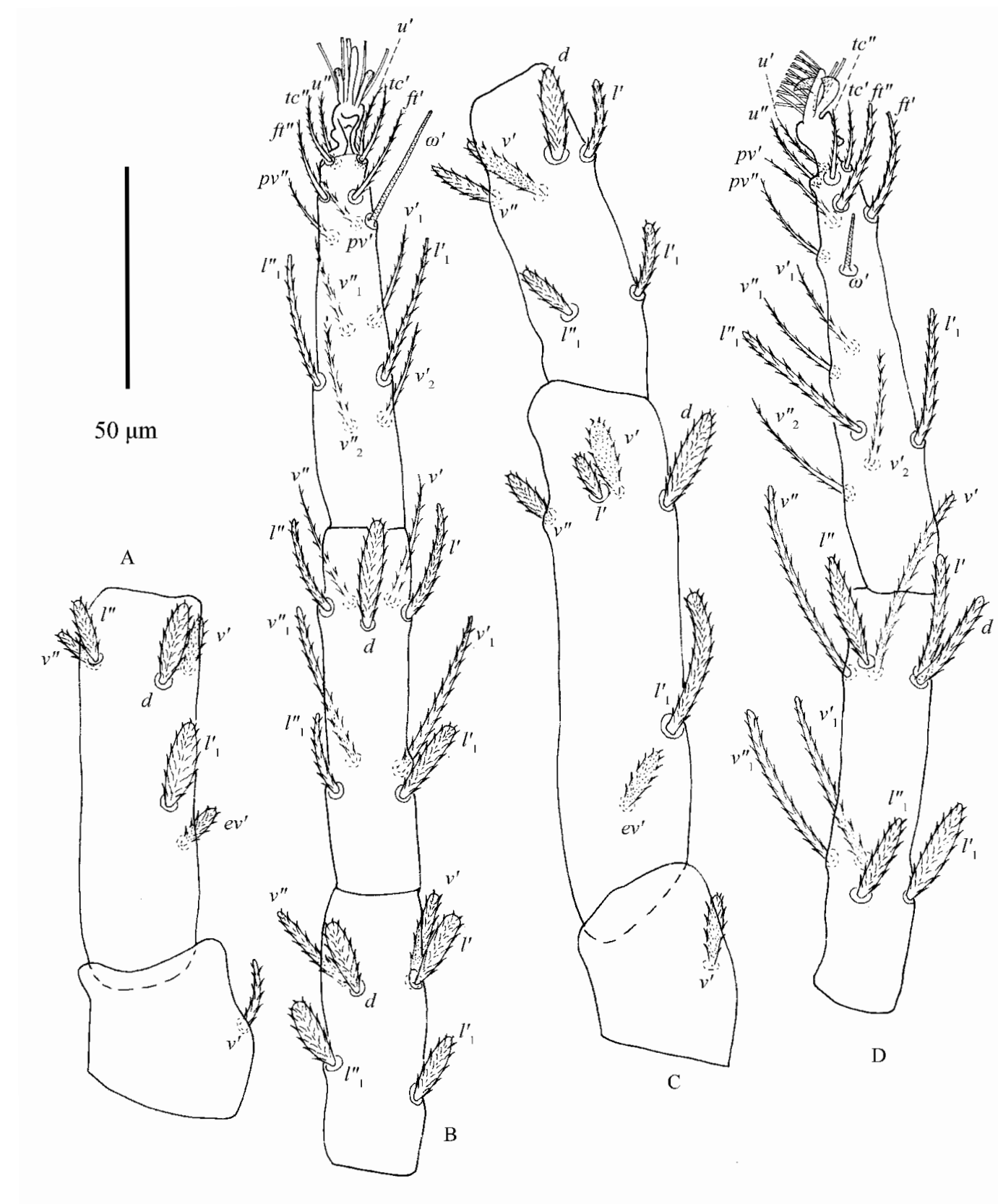


Figure 12 *Bryobia pritchardi*, male, A–B, legs III, D–E, leg IV; right side legs. Scale bar 50 μm.

in length; tarsi III–IV without duplex setae and tarsus III without solenidia, tarsus IV with one solenidion ω' long 17–22.

One solenidion ϕ 30–36 on tibia I. Tibiae II–IV without solenidia. Leg I length 624–692 (measured from trochanter to tarsus), longer than body, length of other legs: leg II 254–384, leg III 333–362, leg IV 384–417. Length of leg segments: trochanter I 42–50, femur I 205–230, genu I 96–114, tibia I 164–180, tarsus I 108–127; trochanter II 35–39, femur II 92–123, genu II 60–68, tibia II 71–81, tarsus II 70–86; trochanter III 33–46, femur III 75–99, genu III 52–65, tibia III 65–84, tarsus III 70–86; trochanter IV 39–45, femur IV 84–114, genu IV 70–76, tibia IV 86–96, tarsus IV 92–100*.

Deutonymph (n=1)

One specimen measured: length of idiosoma 542 (including gnathosoma), 475 (excluding gnathosoma).

Dorsum (Fig. 13) — Prodorsal lobes and dorsal striae similar in shape to female (Fig. 5C), outer lobes do not reach level of inner lobe incision. Dorsal body setae inserted on tubercles (stronger in posterior area), small, orbicular to obovate. Setae v_1 and v_2 longest dorsal setae, subequal in length. Distance between first (v_1) and second (v_2) pair of propodosomal setae insertions 15 and 70, respectively.

Dorsocentral setae c_1 , d_1 and e_1 short, and setae f_1 and f_2 in marginal position. Lengths of dorsal setae: v_1 11, v_2 12, sc_1 10, sc_2 9, c_1 6, c_2 9, c_3 8, d_1 6, d_2 9, d_3 9, e_1 7, e_2 10, e_3 9, f_1 10, f_2 7, h_1 8. Distances between setal bases: c_1 – c_1 46, d_1 – d_1 30, e_1 – e_1 29, c_1 – d_1 105, d_1 – e_1 48.

Venter (Fig. 14) — All ventral setae smooth with the exception of $1c$, $2b$ and $3b$ which are lanceolate, serrate, and seta $1b$ is barbed: $1a$ 27, $1b$ 20, $1c$ 9, $2b$ 13, $3a$ 17, $3b$ 9, $4a$ 12, $4b$ 8, ag 7, g_1 10, ps_1 7, ps_2 8, ps_3 7, h_2 10, h_3 9. Distances between setal bases: $1a$ – $1a$ 49, $3a$ – $3a$ 63, $4a$ – $4a$ 59, g_1 – g_1 32, ag – ag 47.

Gnathosoma (Fig. 22C) — Subcapitular seta m smooth (Fig. 14), long 22, subequal to distance m – m 25; seta $dPFe$ 18 serrate and columned. Seta $l''PGe$ 19, $dPTi$ 15, $l'PTi$ 12, $l''PTi$ 10. Palp tarsus with clavate spinneret, $su\zeta$ 7 in length with nipple-like tip. Single solenidion, ω 5 in length, two eupathidia ($ul'\zeta$ and $ul''\zeta$) subequal, length 5, three normal setae: seta a 12, b 6, c 4.

Legs (Fig. 15) — True claws and empodia similar to that of female. All leg setae barbed (Fig. 15). Number of phaneres on legs I–IV (number of solenidia and eupathidia respectively shown in parentheses):

Trochanter – Femur – Genu – Tibia – Tarsus
leg I – 1 – 9 – 4 – 9 (1) – 13 ($3\omega+3$)
leg II 1 – 3 – 4 – 5 – 9 ($1\omega+3$)
leg III 1 – 2 – 2 – 5 – 10 ($1\omega+0$)
leg IV 1 – 2 – 2 – 5 – 10 ($0\omega+0$)

Tarsus I: two pairs of duplex setae distal and adjacent, proximal solenidion ω' 41, distal solenidia ω'' 55, ω''_1 17; tarsus II with one pair of duplex setae: ω'' 17 in length; tarsi III–IV without duplex setae, tarsus III with one solenidion ω'' 17. Tarsus III with solenidion well-separated from tactile setae, proximal.

One solenidion ϕ 13 on tibia I. Tibiae II–IV without solenidia. Length of leg I 317 (measured from trochanter to tarsus), shorter than body, length of other legs: leg II 224, leg III 223, leg IV 241. Length of leg segments: trochanter I 25, femur I 97, genu I 54, tibia I 76, tarsus I 64; trochanter II 21, femur II 58, genu II 43, tibia II 52, tarsus II 52; trochanter III 27, femur III 55, genu III 39, tibia III 46, tarsus III 56; trochanter IV 25, femur IV 64, genu IV 43, tibia IV 51, tarsus IV 59.

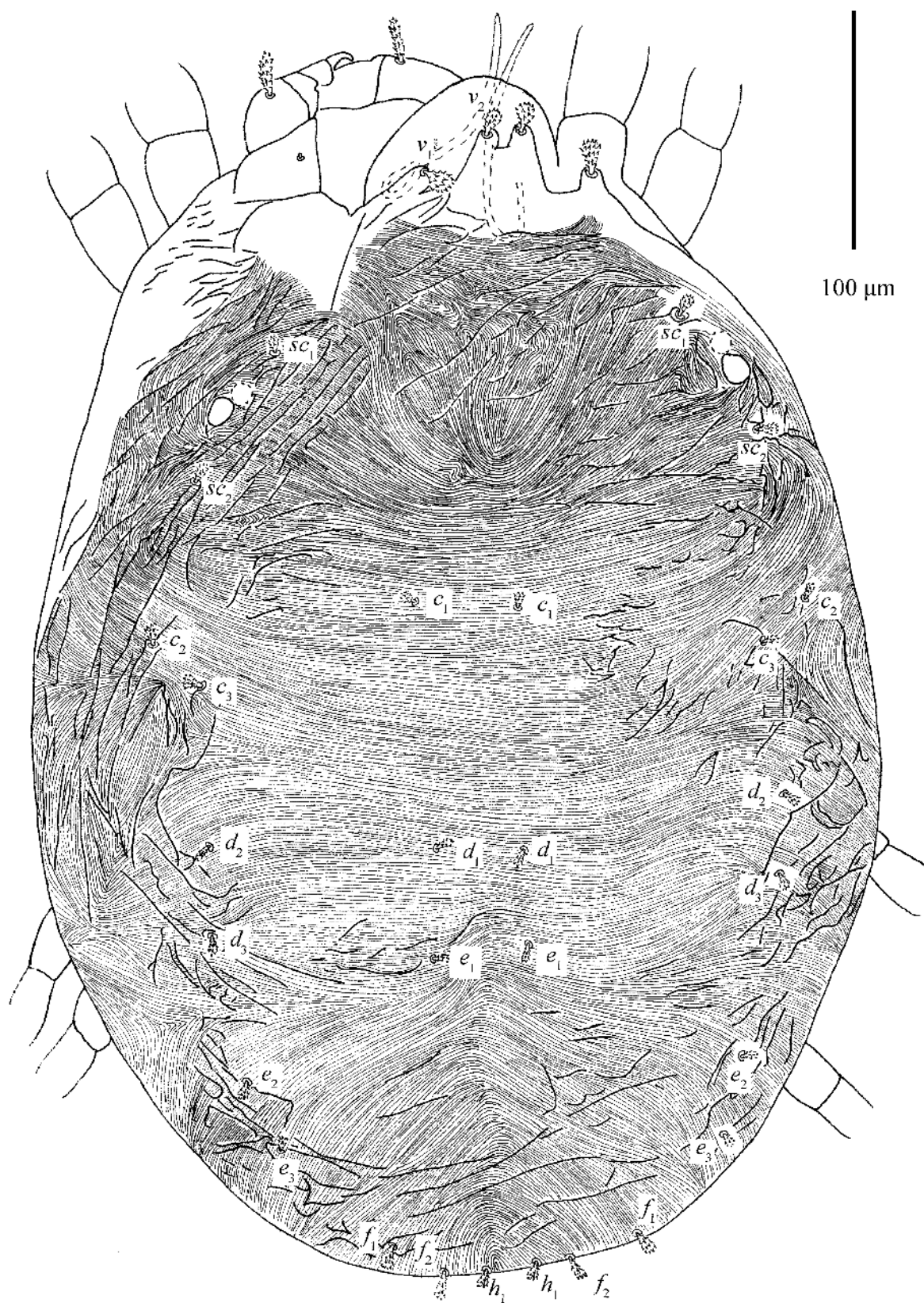


Figure 13 *Bryobia pritchardi*, deutonymph, dorsal idiosoma. Scale bar 100 μ m.

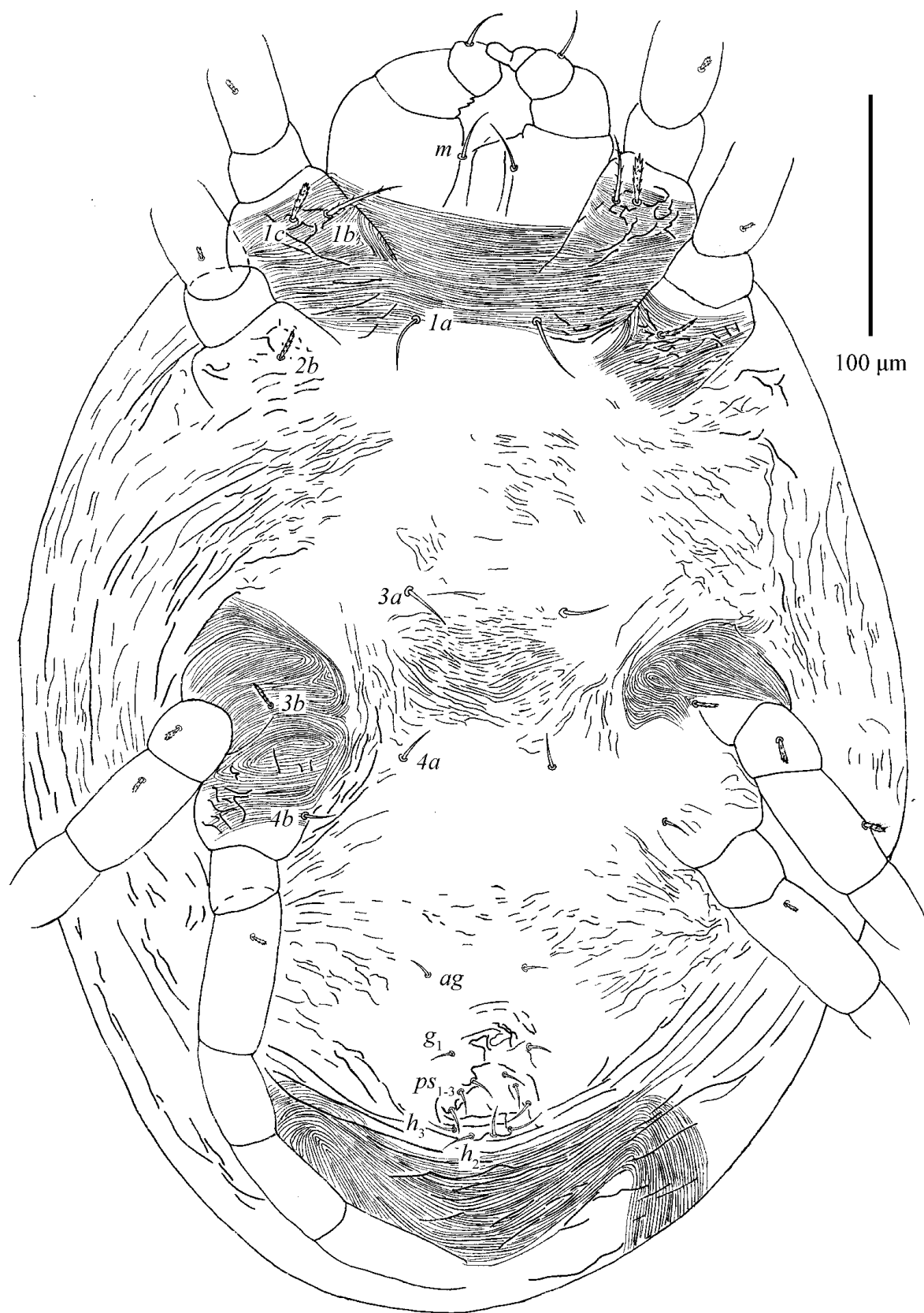


Figure 14 *Bryobia pritchardi*, deutonymph, ventral view. Scale bar 100 μm.

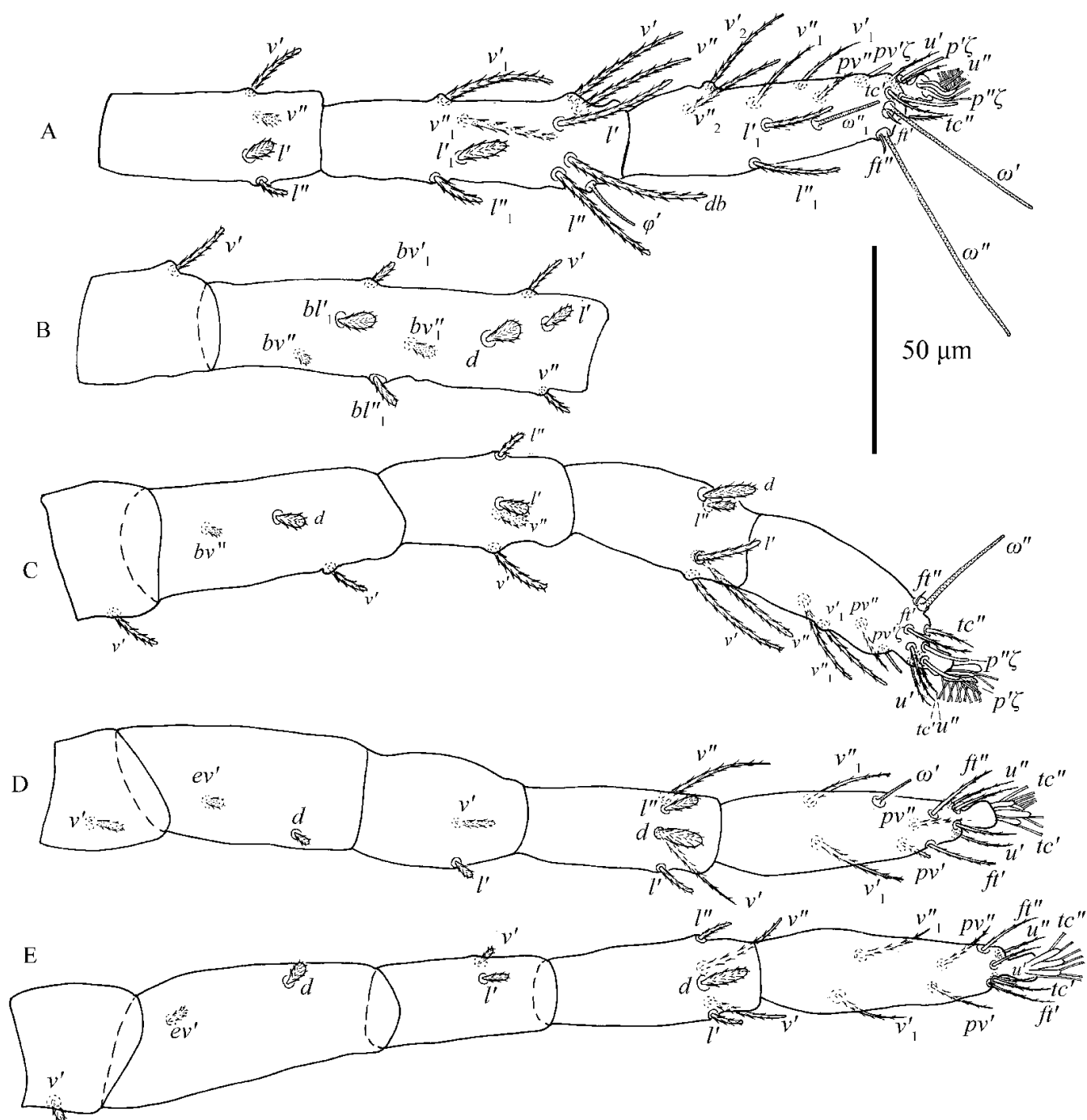


Figure 15 *Bryobia pritchardi*, deutonymph, A–E, legs I–IV: leg I, II and IV, right side legs; leg III, left side leg. Scale bar 50 μ m.

Protonymph (n=5)

Dorsum (Fig. 16) — Length of idiosoma 416–453 (including gnathosoma), 338–394 (excluding gnathosoma). Dorsal striae similar in shape to female. Propodosomal lobes (Fig. 5B) shorter than those of deutonymph; rest of dorsum resembles that of deutonymph. Prodorsal lobes weakly developed, tubercle like, $v1$ 10–15, spatulate and serrate, shorter than $v2$ 29–42, spatulate and serrate with spiky appearance. Dorsocentral setae ($c1$, $d1$ and $e1$) short. Setal lengths: $sc1$ 7–10, $sc2$ 7–9, $c1$ 5–7, $c2$ 5–11, $c3$ 7–8, $d1$ 4–7, $d2$ 5–8, $d3$ 6–8, $e1$ 5–7, $e2$ 7–11, $e3$ 6–7, $f1$ 6–8, $f2$ 6–8, $h1$ 6–9. Distances between setal bases: $v1-v1$ 12–15, $v2-v2$ 44–55, $c1-c1$ 26–43, $d1-d1$ 26–41, $e1-e1$ 27–35, $c1-d1$ 58–68, $d1-e1$ 26–69, $h1-h1$ 19–37.

Venter (Fig. 17) — Ventral setae shorter than those of deutonymph. All ventral setae smooth with the exception of $1c$, $2b$ and $3b$ lanceolate and serrate: $1a$ 14–20, $1b$ 19–22, $1c$ 10–13, $2b$ 6–10, $3a$ 11–16, $3b$ 7–8, ag 6–9, $ps1$ 7–10, $ps2$ 6–8, $ps3$ 6–8, $h2$ 7–11, $h3$ 10–10. Distances between setal bases: $1a-1a$ 36–42, $3a-3a$ 37–65, $ag-ag$ 27–52.

Gnathosoma (Figs. 22A, D) — Subcapitular seta m 20–24 smooth, slightly longer than distance $m-m$ 16–20; seta $dPFe$ 12–16 serrate and columned, seta $l'PGe$ length 13–16, $dPTi$ 11–12, $l'PTi$ 8–11, $l''PTi$ 5–7. Palp tarsus with clavate spinneret, $su\zeta$ 8–9. Single solenidion, ω 6–7, two eupathidia ($ul'\zeta$ and $ul''\zeta$) subequal in length 3–5, three normal setae: a 8–11, b 5–6, c 3–6.

Legs (Fig. 18) — True claws and empodia resembles those of female. All leg setae barbed (Fig. 18). Number of phaneres on legs I–IV (number of solenidia and eupathidia respectively shown in parentheses):

Trochanter – Femur – Genu – Tibia – Tarsus
leg I – 0 – 3 – 4 – 5 (1) – 9 (2 ω +3)
leg II – 0 – 3 – 4 – 5 – 7 (1 ω +3)
leg III – 0 – 2 – 2 – 5 – 8 (0 ω +0)
leg IV – 0 – 2 – 2 – 5 – 6 (0 ω +0)

Tarsus I: two pairs of duplex setae distal and adjacent, ω' 28–33, ω'' 44–53 in length; tarsus II with one pair of duplex setae: ω'' 19–20 in length; tarsi III–IV without solenidia.

One solenidion ϕ 10–11 on tibia I. Tibiae II–IV without solenidia. Length of leg I 207–223 (measured from trochanter to tarsus), shorter than body, length of other legs: leg II 138–177, leg III 158–164, leg IV 158–171. Length of leg segments: trochanter I 21–24, femur I 53–65, genu I 37–39, tibia I 41–48, tarsus I 49–55; trochanter II 17–21, femur II 35–45, genu II 21–35, tibia II 28–32, tarsus II 39–41; trochanter III 21–24, femur III 32–38, genu III 25–28, tibia III 33–38, tarsus III 39–45; trochanter IV 22–25, femur IV 37–44, genu IV 26–28, tibia IV 29–35, tarsus IV 45–46*.

Larva (n=6)

Dorsum (Fig. 19) — Length of idiosoma 301–361 (including gnathosoma), 249–338 (excluding gnathosoma). Dorsal striae irregular, not finger-print like, sparse on opisthonotum. Prodorsal lobes absent, $v1$ very short, seta $v2$ 18–23 about three times as long as seta $v1$ 6–7 (Fig. 5A). Other dorsal setae resemble that of protonymph. Dorsocentral setae ($c1$, $d1$ and $e1$) short. Setal lengths: $sc1$ 8–16, $sc2$ 8–10, $c1$ 5–7, $c2$ 6–9, $c3$ 9–11, $d1$ 5–5, $d2$ 7–8, $d3$ 5–5, $e1$ 5–6, $e2$ 6–6, $e3$ 6–10, $f1$ 9–15, $f2$ 9–13, $h1$ 9–12. Distances between setal bases: $v1-v1$ 12–21, $v2-v2$ 43–51, $c1-c1$ 29–39, $d1-d1$ 15–23, $e1-e1$ 14–20, $c1-d1$ 40–64, $d1-e1$ 39–47.

Venter (Fig. 20) — Ventral setae shorter than those of protonymph: $1a$ 14–17, $1b$ 12–20, $3a$ 16–19, $ps1$ 7–8, $ps2$ 6–8, $ps3$ 7–8, $h2$ 10–13, $h3$ 10–12. Distances between setal bases: $1a-1a$ 33–39, $3a-3a$ 49–67.

Gnathosoma (Figs. 22B, E) — Seta $dPFe$ serrate and columned, 10–12 in length, Seta $l'PGe$ 9–12, $dPTi$ 11–12, $l'PTi$ 8–11, $l''PTi$ 5–6. Palp tarsus, $su\zeta$ 6–7. Single solenidion, ω 6–8, two eupathidia ($ul'\zeta$ and $ul''\zeta$) subequal in length 4–5, three normal setae: a 8–11, b 5–6, c 4.

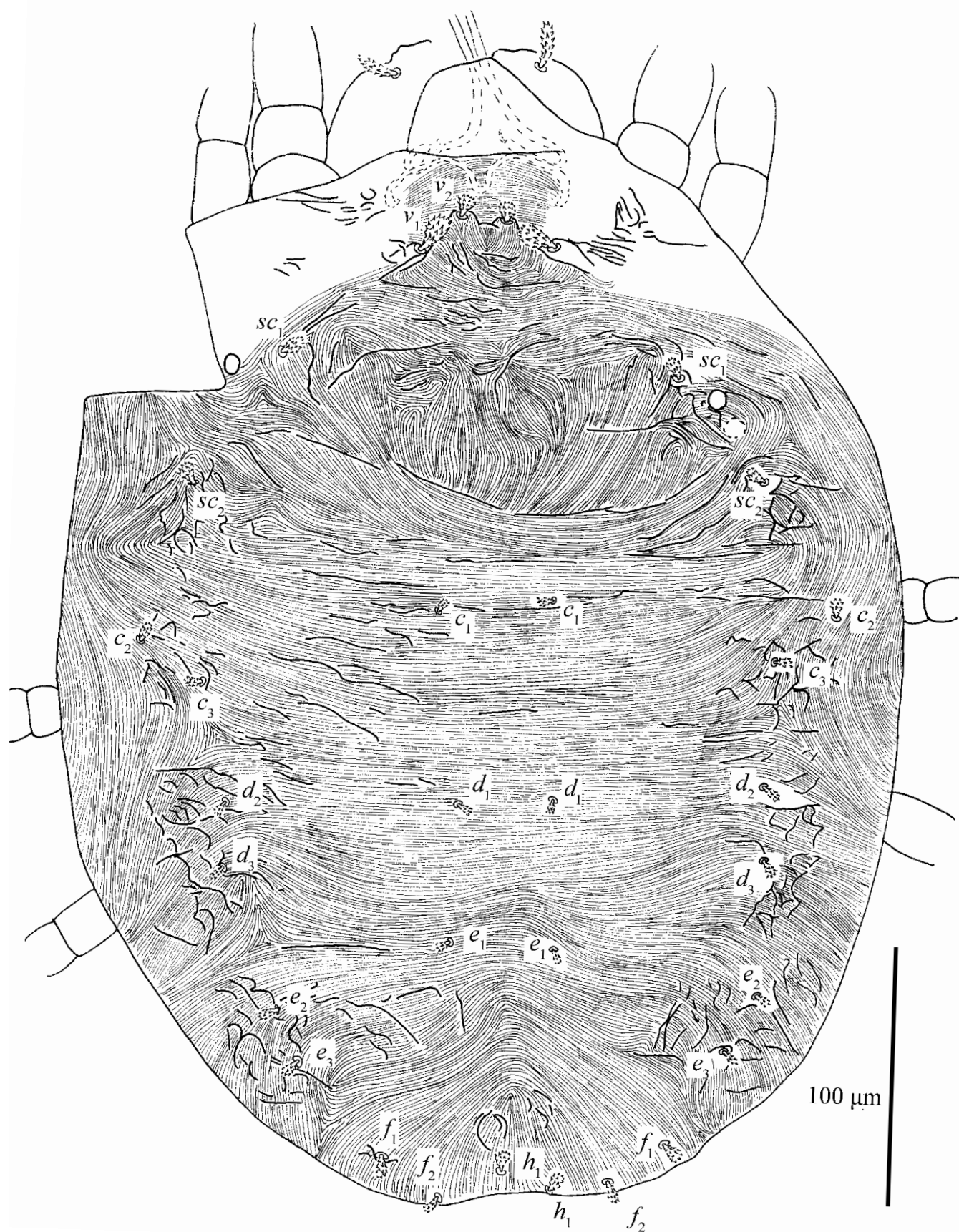


Figure 16 *Bryobia pritchardi*, protonymph, dorsal idiosoma. Scale bar 100 μ m.

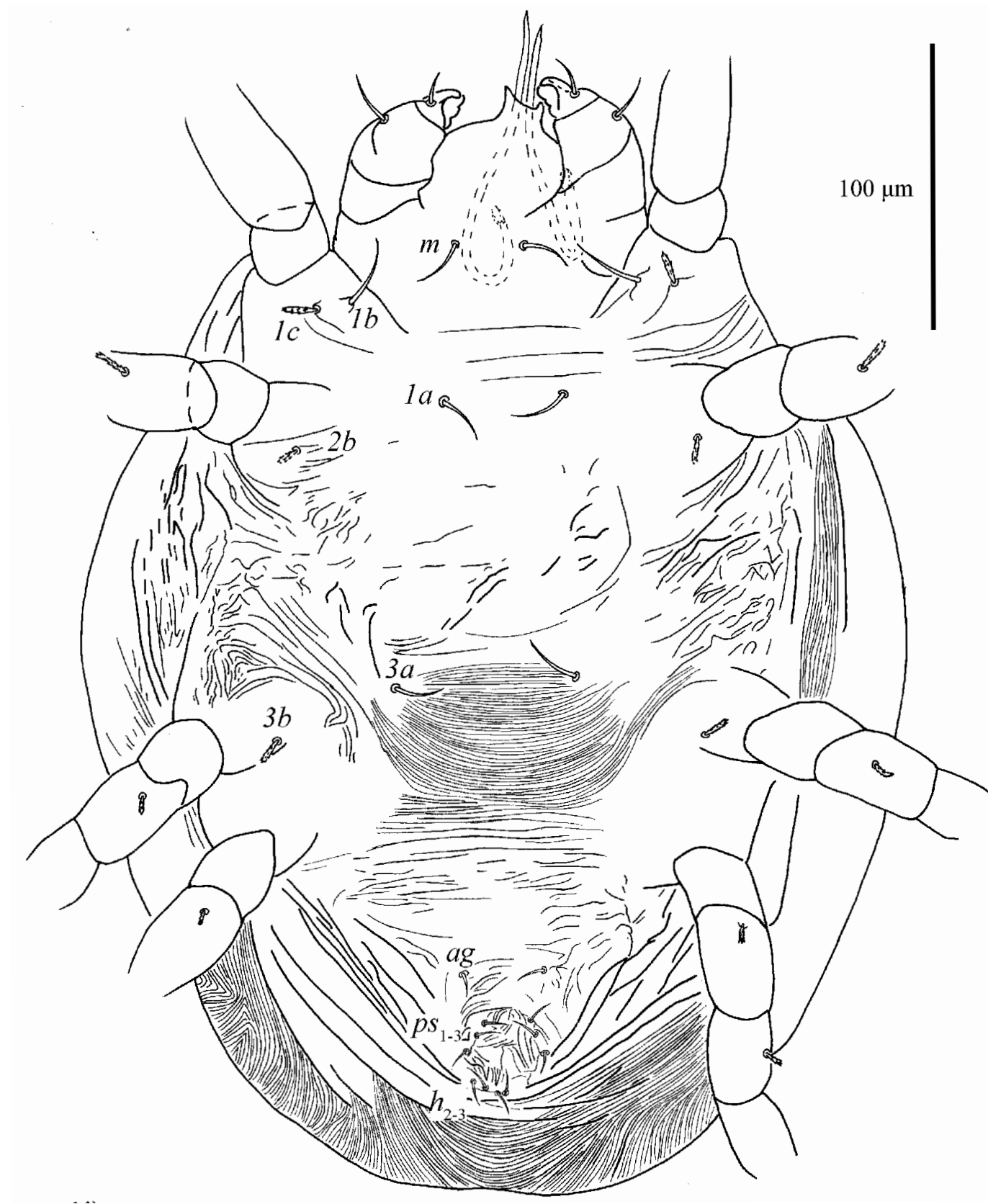


Figure 17 *Bryobia pritchardi*, protonymph, ventral view. Scale bar 100 μm.

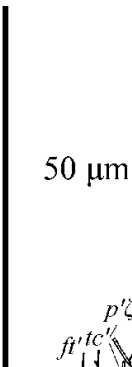


Figure 18 *Bryobia pritchardi*, protonymph, A–D, legs I–IV: leg I and IV, left side legs; leg II–III, right side legs. Scale bar 50 μ m.

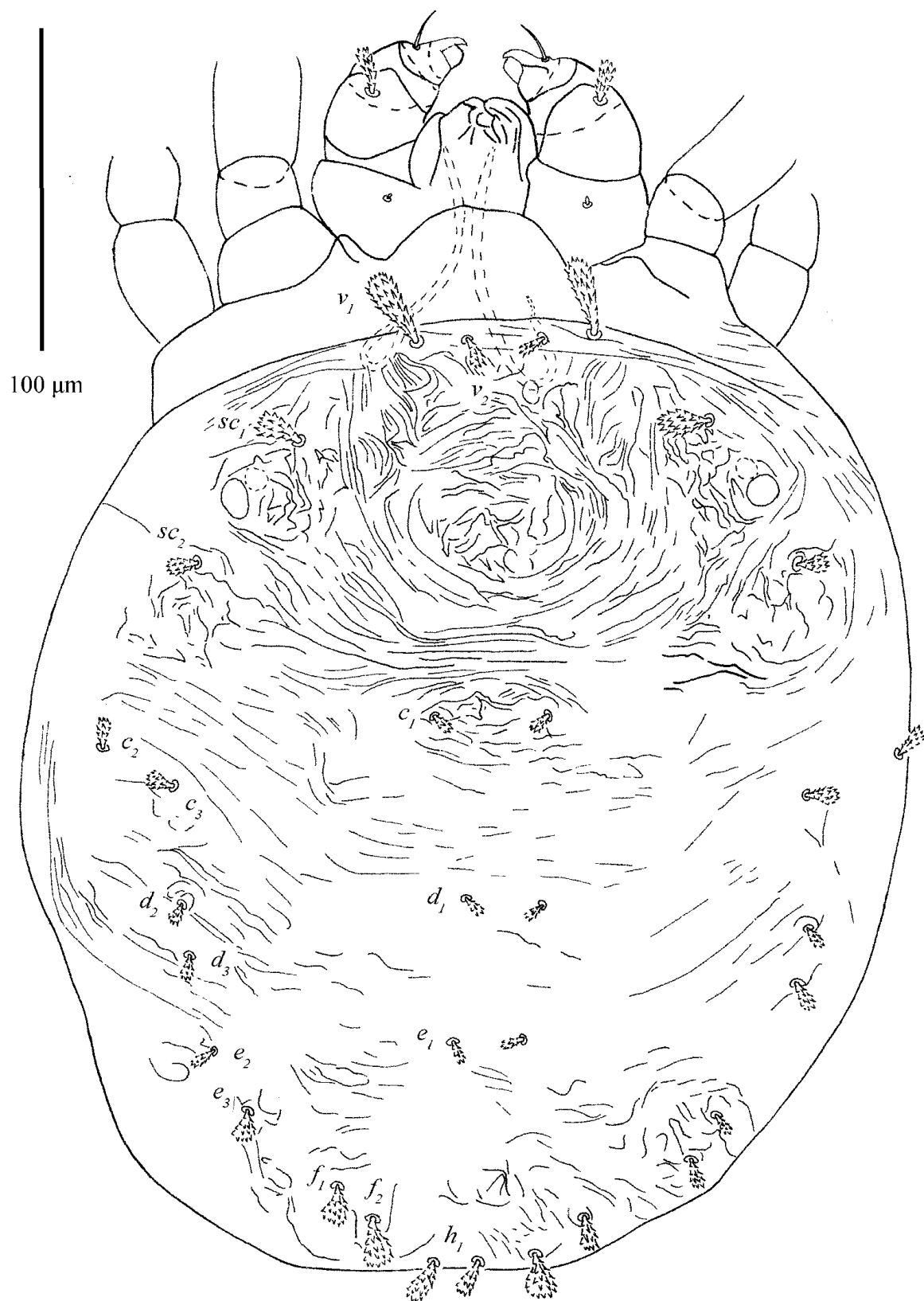


Figure 19 *Bryobia pritchardi*, larva, dorsal idiosoma. Scale bar 100 μ m.

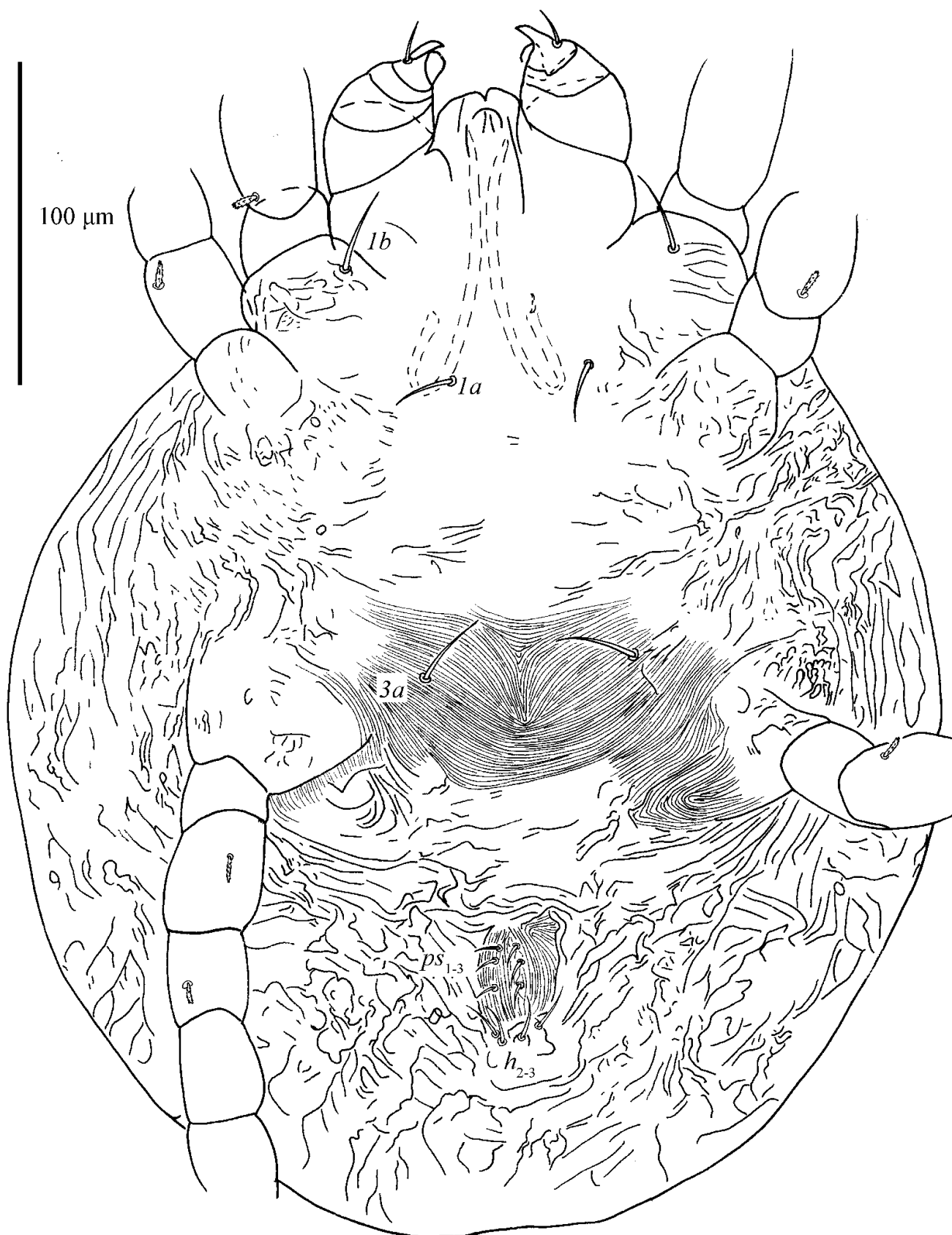


Figure 20 *Bryobia pritchardi*, larva, ventral view. Scale bar 100 μ m.

Legs (Fig. 21) — All leg setae barbed. Number of phaneres on legs I–IV (number of solenidia and eupathidia respectively shown in parentheses):

Trochanter – Femur – Genu – Tibia – Tarsus
leg I – 0 – 3 – 4 – 5 (1) – 5 (1 ω +3)
leg II – 0 – 3 – 4 – 5 – 6 (1 ω +2)
leg III – 0 – 2 – 2 – 5 – 6 (0 ω +0)

Tarsus I: one pair of duplex setae, ω'' 35–53 in length; tarsus II with one pair of duplex setae: ω'' 16–23; tarsi III–IV without solenidia.

One solenidion ϕ on tibia I, length 9–14. Tibiae II–IV without solenidia. Length of leg I 160–177 (measured from trochanter to tarsus), shorter than body, length of other legs: leg II 129–136, leg III 137–153. Length of leg segments: trochanter I 18–23, femur I 40–48, genu I 24–28, tibia I 33–35, tarsus I 45–49; trochanter II 17–22, femur II 29–34, genu II 18–25, tibia II 22–27, tarsus II 35–37; trochanter III 15–26, femur III 30–36, genu III 21–25, tibia III 26–29, tarsus III 38–43.

Remarks

Comparison with the type specimens showed a perfect match in the setal number of adult female legs I–IV as follows: trochanters 1–1–1–1; femora 16–10–5–5; genera 8–5–6–6; tibiae 15 (1 ϕ)–9–9–9; tarsi 19 (5 ω +2dup)–17 (0 ω +1dup)–15 (0 ω)–14 (1 ω). The type specimens also match in dorsal setae, which are spatulate to orbicular, rough, serrate, with small bulge-like

Table 1 Ontogenetic additions of leg setae in *Bryobia pritchardi*.

Leg		Co	Tr	Fe	Ge	Ti	Ta
I	L	1b	-	d, v', bv''	(l), (v)	db, (l), (v), ϕ	(p ζ), (ft), (u), (pv), ω''
	P	1c	-	-	-	-	(tc), ω' , l', v' ₁
	D	-	v'	v'', l', , (bv ₁), (bl ₁)	-	(l ₁), (v ₁)	l'' ₁ , v'' ₁ , (v ₂), ω'' ₁
	F	-	-	l'', l', l' ₂ , (v ₁), (v ₂)	(l ₁), (v ₁)	(v ₂), (v ₃), (l ₂)	(ω ₂), (v ₃), (l ₂), (ω ₃), v' ₄
	M	-	-	l'', (l ₁), (v ₁), (l ₂), v' ₂	(l ₁), (v ₁)	(v ₂), (v ₃), (l ₂)	ω' ₁ , (ω ₂), (ω ₃), (l ₂), (v ₃), (ω ₄), ω' ₅
II	L	-	-	d, v', bv''	(l), (v)	d, (l), (v)	(p ζ), (ft), (u), (pv), ω''
	P	-	-	-	-	-	(tc)
	D	2b	v'	-	-	-	(v ₁)
	F	-	-	v'', (l), (v ₁), (l ₁)	l'' ₁	(l ₁), (v ₁)	(v ₂), (v ₃), (l ₁)
	M	-	-	v'', (l), (v ₁), l'' ₁ , (l ₂)	l'' ₁	(l ₁), (v ₁)	(v ₂), v'' ₃ , (l ₁)
III	L	-	-	d, ev'	v', l'	d, (l), (v)	(pv), (ft), (u)
	P	3b	-	-	-	-	(tc)
	D	-	v'	-	-	-	(v ₁)
	F	-	-	(v), l' ₁	d, v'', (l ₁)	(l ₁), (v ₁)	(v ₂), v'' ₃ , (l ₁)
	M	-	-	(v), l'', l' ₁	d, v'', (l ₁)	(l ₁), (v ₁)	(v ₂), (l ₁)
IV	P	4a, 4b	-	d, ev'	v', l'	d, (l), (v)	(pv), (u), (ft)
	D	-	v'	-	-	-	(tc), (v ₁)
	F	-	-	v', l', l' ₁	d, (l ₁), v''	(v ₁), (l ₁)	ω' , (v ₂), (l ₁)
	M	-	-	(v), l', l' ₁	d, (l ₁), v''	(v ₁), (l ₁)	ω' , (v ₂), (l ₁)

†: Setae are indicated in the stage in which they first appear. L: larva, P: protonymph, D: deutonymph, F: female, M: male. The number of female tarsus I and femur I are 16, 18 (7 ω +3), respectively.

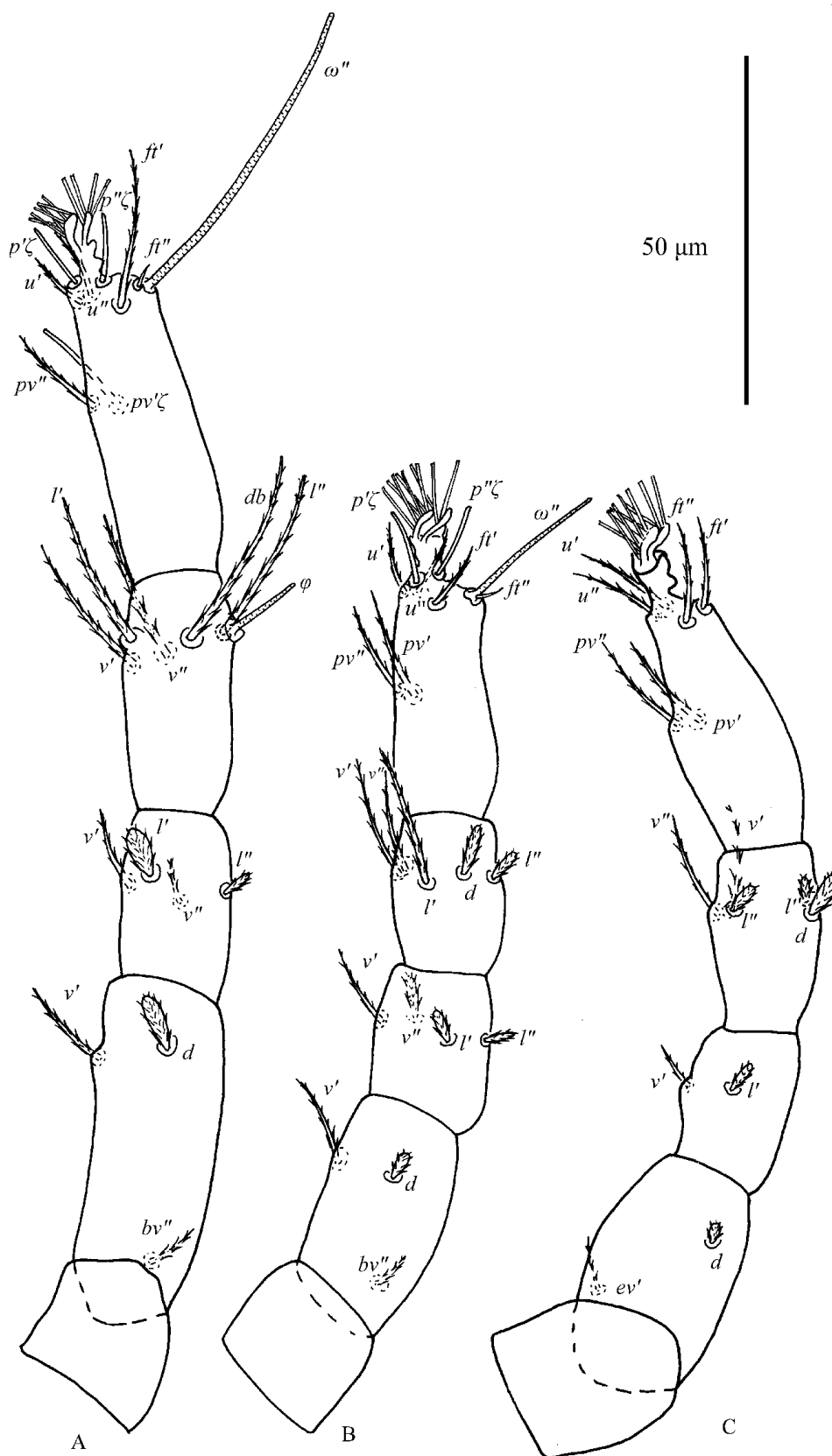


Figure 21 *Bryobia pritchardi*, larva, A–C, legs I–III: right sides legs. Scale bar 50 μ m.

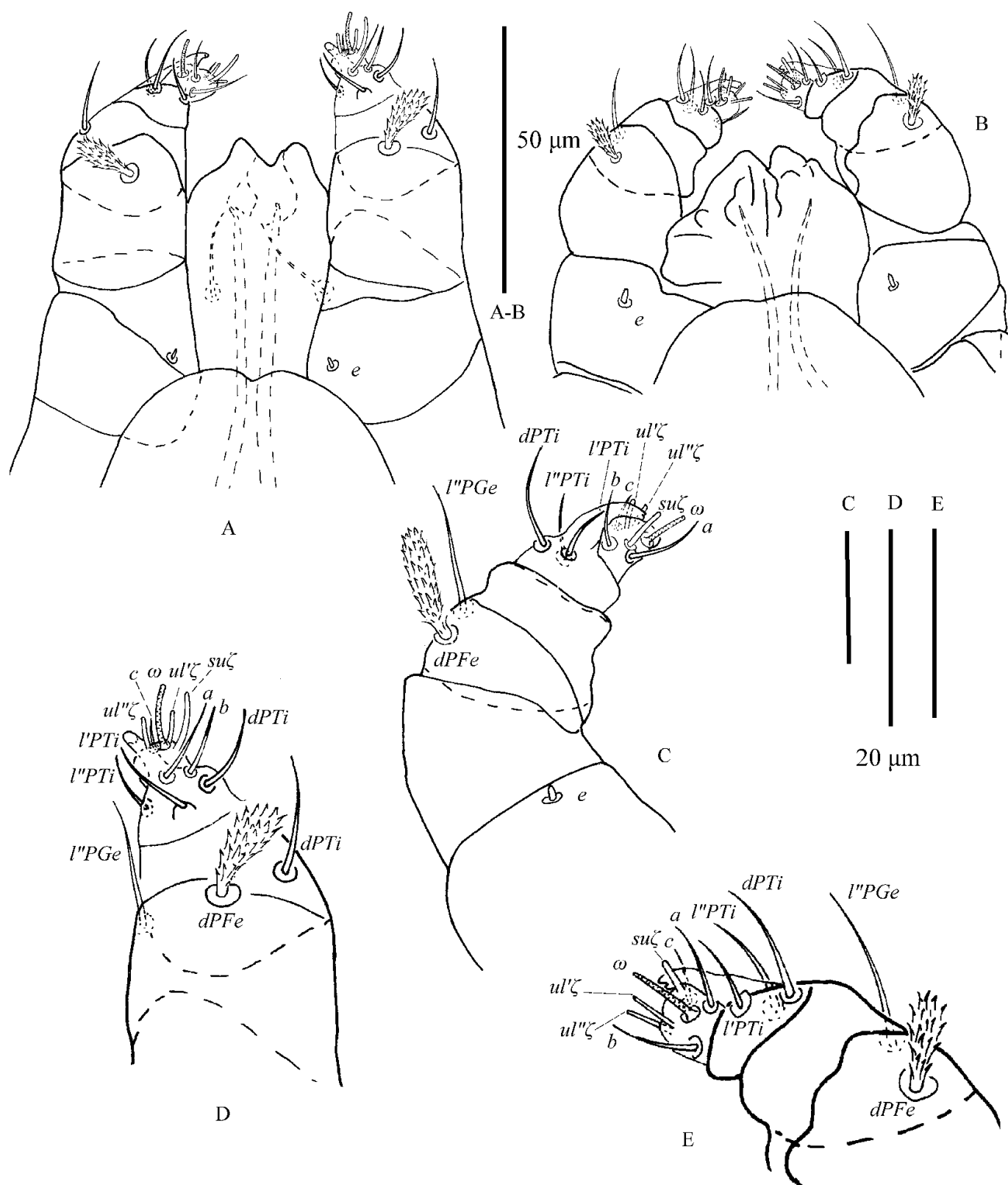


Figure 22 *Bryobia pritchardi*, deutonymph, C, gnathosoma, dorsal view; protonymph, A, gnathosoma, dorsal view, D, palp; larva, B, gnathosoma, dorsal view, E, palp. Scale bars A–B 50 μm, C–E 20 μm.

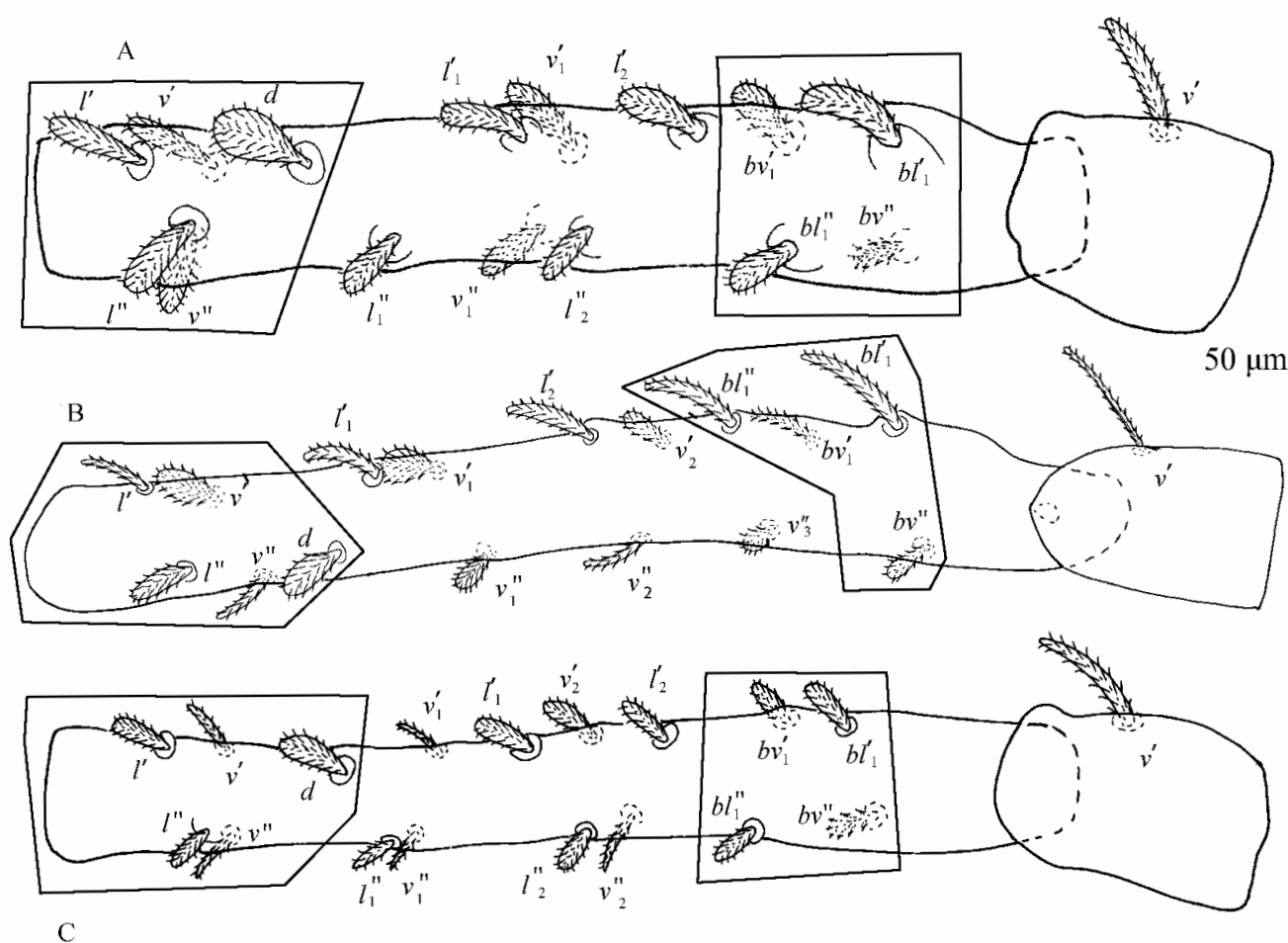


Figure 23 *Bryobia pritchardi*, setae number of female femur I: A, 15 setae; B, 16 setae; C, 17 setae. Invariable setae (d , $v'-v''$, $l'-l''$, bv'' , $bv'1$, $bl'1-bl''1$) are shown with the frames; the remaining setae always vary in position and number.

bases (Figure 25B). Additionally, they share similar prodorsal lobes, which are well-developed, the inner lobes sharing a more or less triangular broad base, and are well separated distally with an obvious incision (Figure 25E).

Bryobia pritchardi is most similar to *B. praetiosa* Koch, 1836, with both species characterized by: the shape of the dorsal setae; having strong anterior propodosomal projections; and empodia II-IV about as long as the claw, with two rows of ventrally directed tenent hairs. *B. pritchardi* is diagnosed by empodia I, which bears two rows of three ventrally directed tenent hairs, and true claws I have 3 pairs of tenent hairs. In *B. praetiosa*, empodia I has only a single pair of tenent hairs, and true claw I is pad-like and has more than three pairs of tenent hairs (Pritchard & Baker 1955; Ehara 1956).

We also note the recent work of Fashing (2016), who demonstrated that the prodorsal lobes, a critical feature for species and even genus level differentiation, is prone to intraspecific variation. However, here we found no variation within our populations, but we do draw attention to the differences between life stages and sexes (Fig. 5).

The addition of leg setae on adult spider mites is potentially more variable in the Bryobiinae than in the Tetranychinae because of the richer setation in the former, especially on the tarsus and femur of adults. On occasion, in the genus *Bryobia*, the tactile setae on femur and tarsus I may vary in number within the same species, having fewer or more than the typical pattern (Tables 2, 3). From 25 specimens of *B. pritchardi*, we found that the typical pattern in this

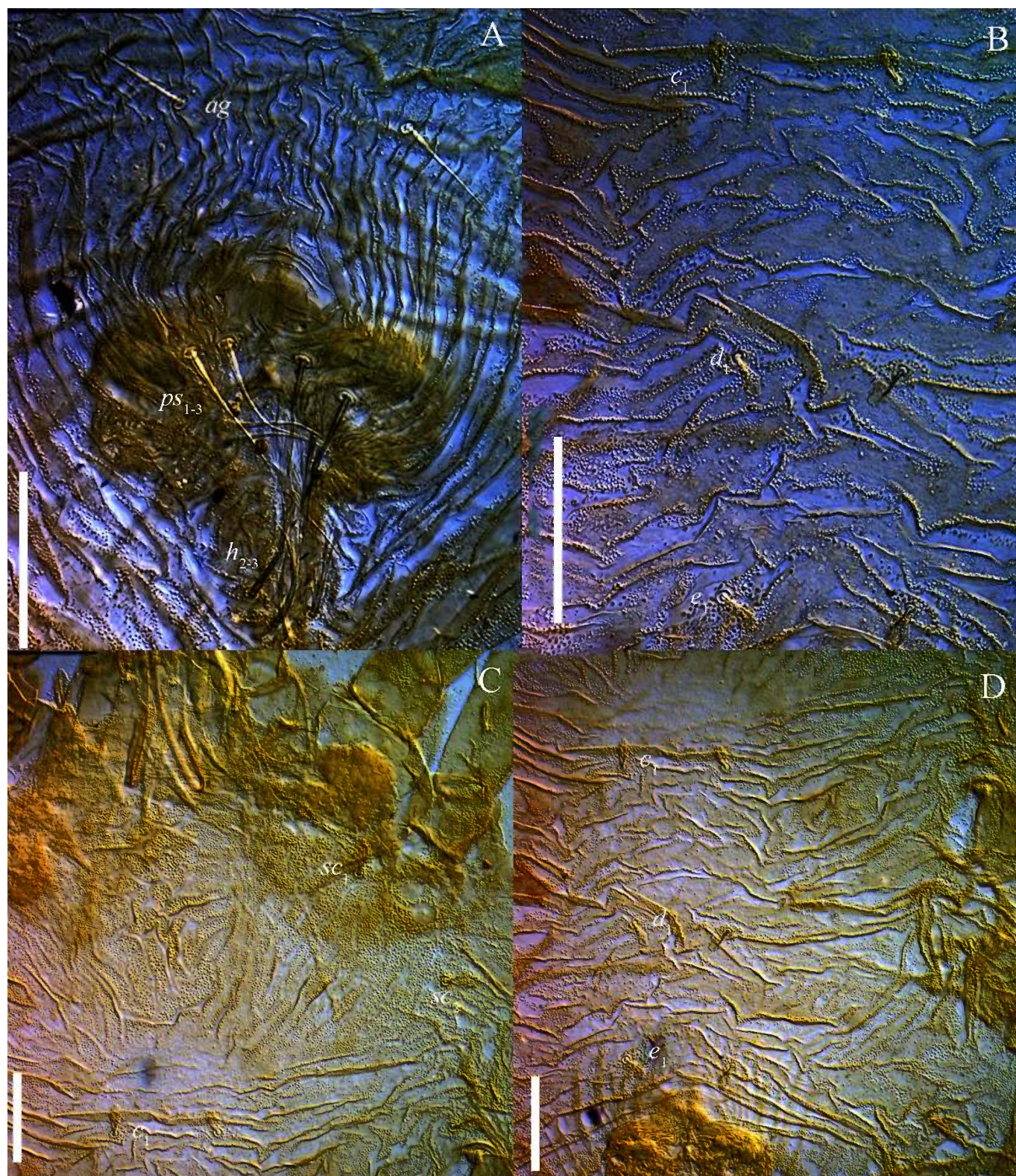


Figure 24 *Bryobia pritchardi*, photographs. Female holotype: A, genital and anal region; B, the dorsum between $c1$ to $e1$; C, prodorsum; D, the dorsum between $c1$ to $e1$. Scale bars A–D 50 μ m.

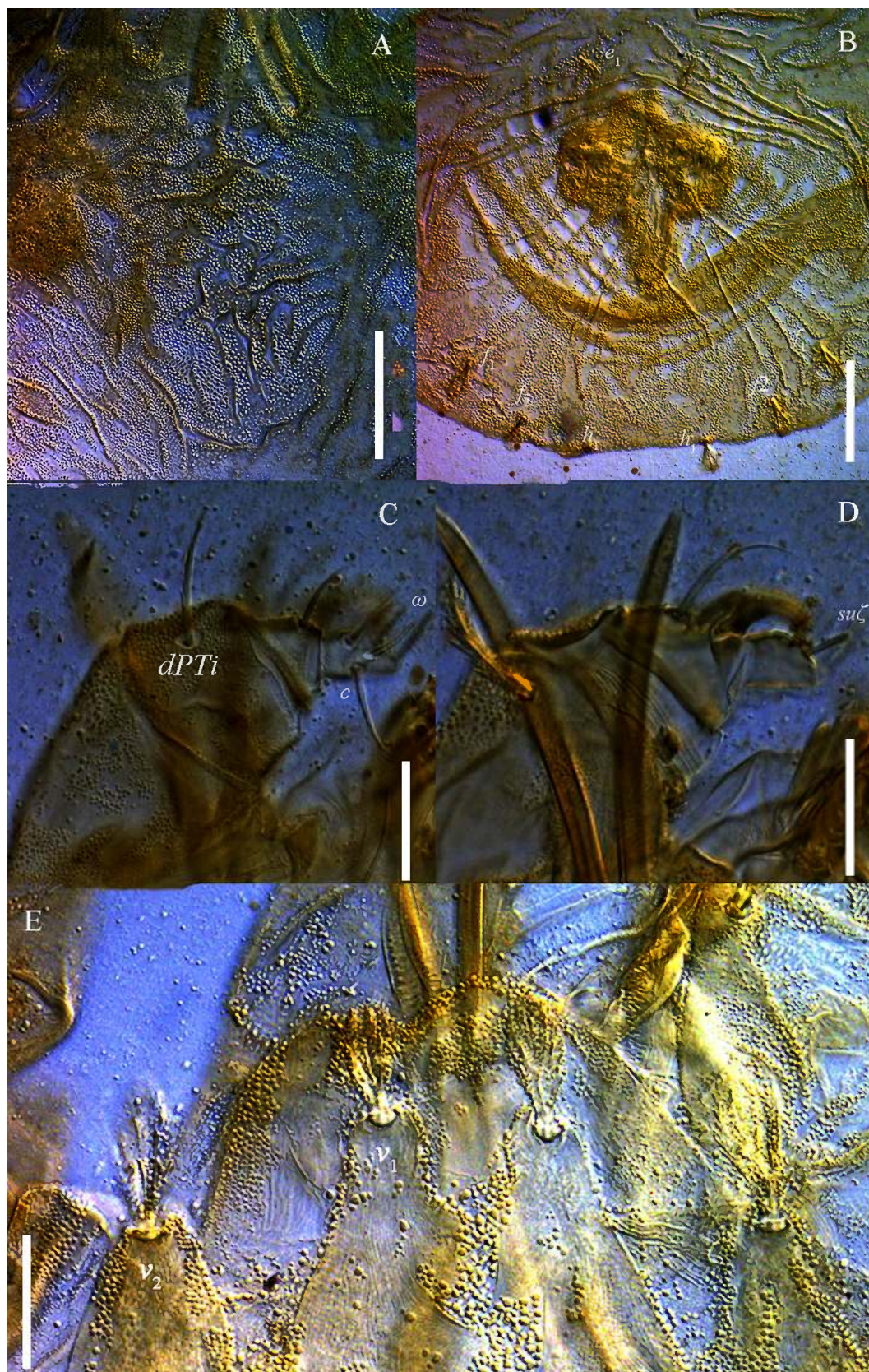


Figure 25 *Bryobia pritchardi*, photographs. Female holotype: A, propodosomal striae; B, opisthosoma posterior section; C, palp dorsal view; D, palp ventral view; E, propodosomal projections (v1 and v2). Scale bars A–B, E 50 μ m; C–D, 20 μ m.

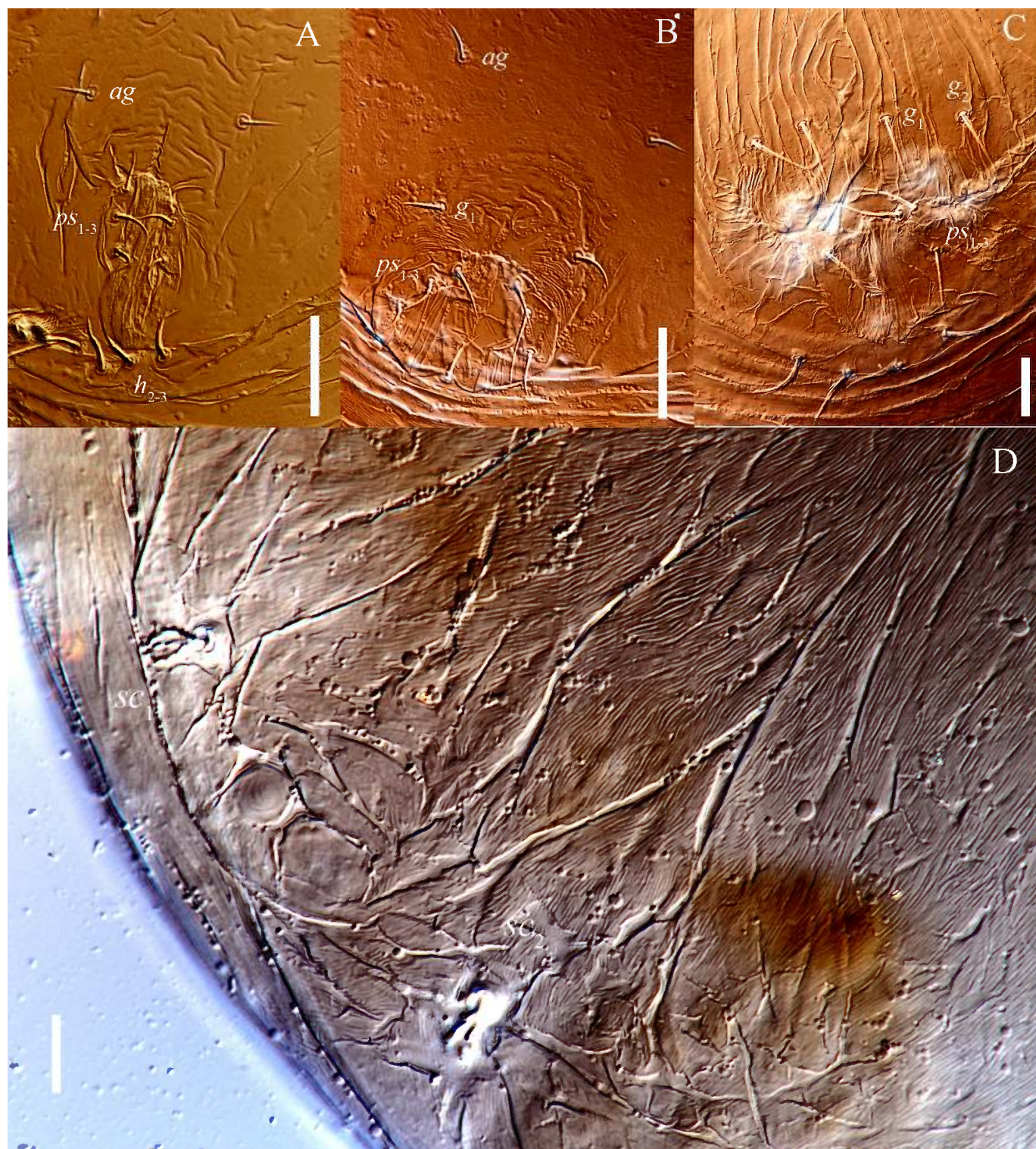


Figure 26 *Bryobia pritchardi*, photographs. Ventral views of hysterosoma: A, protonymph; B, deutonymph. Female: C, genital and anal region; D, the dorsal striae between *sc*1 to *sc*2. Scale bars A–C, 10 μ m; D, 50 μ m.

Table 2 Setal count and variation in female tarsus I of *Bryobia pritchardi* based on 25 specimens (“-” absent setae; “+” excess setae).

Specimens	NR	NL	Specimens	NR	NL
n1	28	27 - v'_4	n14	28	28
n2	28	29 + ω'_1	n15	27 - v'_4	28
n3	28	27 - ω'_2	n16	28	28
n4	28	28	n17	28	27 - ω''_3
n5	28	28	n18	28	28
n6	28	28	n19	28	28
n7	28	28	n20	28	26 - ω'_3, v'_4
n8	26 - ω'_2, l''_2	27 - v'_4	n21	28	28
n9	28	28	n22	28	28
n10	28	28	n23	28	28
n11	28	28	n24	28	27 - l''_2
n12	28	28	n25	27 - l''_2	27 - l''_2
n13	25 - v''_2, v''_3, v'_4	28			

Notes: “NR” present the number of right leg tarsus I female; “NL” present the number of left leg tarsus I female (right leg and left leg from one specimen); “28” indicate tarsus I female with 28 setae (including seven solenidia ($\omega'_1, \omega'_2, \omega'_3, \omega'_4, \omega'_5, \omega'_6, \omega'_7$), 21 tactile setae ($p\zeta'', ft'', u'', pv'\zeta'', tc'', l''_1, l''_2, l''_3, l''_4, l''_5, l''_6, l''_7, l''_8, l''_9, l''_{10}, l''_{11}, l''_{12}, l''_{13}, l''_{14}, l''_{15}, l''_{16}, l''_{17}, l''_{18}, l''_{19}, l''_{20}, l''_{21}$), which is the typical pattern in tarsus I.

species for tarsus I of the female is 28 setae, including seven solenidia (Table 1). Ten setae ($p\zeta''-p\zeta'', ft''-ft'', u''-u'', pv'\zeta''-pv'', tc''-tc''$) are “constant setae” and are typically added earlier in ontogeny, whereas the remaining setae, which tend to be added later in ontogeny (7 solenidia and 11 tactile setae), are mutative, which is very similar to the results found by Seeman *et al.* (2017) for *Eotetranychus*, and also Wauthy’s (1998) work on *Tetranychus*.

Most additions or losses were expressed asymmetrically, with only one specimen (n=25, Table 2) with a symmetrical setal loss. The asymmetrical variation in the other nine specimens was the loss of seta v'_4 (n=2), loss of seta l''_2 (n=2), loss of solenidium ω'_2 or ω'_3 (n=2), addition of solenidium ω'_1 (n=1); loss of setae v''_2, v''_3, v'_4 (n=1); loss of ω'_2, l''_2 (n=1); and loss of ω'_3, v'_4 (n=1) (Table 2).

Femur I is also variable (Fig. 23; Table 3) with two main types of variation: (1) 50% specimens (n=13) present the symmetry on femur I (one type): including ten specimens are type “16 (femur I setae number of left)–16 (femur I setae number of right)”; two with “17–17”; one with “15–15”; (2) 50% specimens (n=12) show asymmetry on femur I (one type): eight specimens with “17–16”; three with “15–16”; one with “15–17” (Table 3).

Discussion

Ontogenetic development of podosoma

The ontogenetic changes of *B. pritchardi* are listed in Table 1.

The setation and ontogeny of idiosomal setae is typical for the Bryobiinae (Lindquist 1985). All dorsal setae and pseudanal setae are present throughout all stages. Ventral setae (*1c*, *2c* and *3b*) are added in the protonymph, *2b*, *4a* and *4b* are added in the deutonymph. Aggenital setae

Table 3 Setal count and variation in female femur I of *Bryobia pritchardi* based on 25 specimens (R: the number of right leg; L: the number of left leg, from one specimen).

Specimens	R	L	Specimens	R	L
n1	16	16	n14	17	16
n2	16	16	n15	16	17
n3	16	16	n16	17	16
n4	16	16	n17	17	16
n5	16	16	n18	17	16
n6	16	16	n19	17	16
n7	16	16	n20	17	16
n8	16	16	n21	16	17
n9	16	16	n22	15	16
n10	15	16	n23	15	16
n11	17	17	n24	15	16
n12	17	17	n25	15	17
n13	15	15			

ag are added in the protonymph; the first pair of genital setae *g1* are added in the deutonymph. The second pair *g2* are added in the adults, with males grouping their genital setae closely as a series of five pairs on the genitoanal valves (Lindquist 1985; Figs. 27A–B).

Ontogenetic development of leg setae

Leg I: Compared with the basic pattern described by Lindquist (1985), there are variations of leg setae found on the tarsus and femur, while almost no variation was found on the tibia, genu and trochanter.

On the larva, the number of setae from the tarsus to trochanter is 8 (1ω)–5 (1ω)–4–3–0. There are eight setae (pv' – pv'' , $p\zeta'$ – $p\zeta''$, fl' – fl'' , u' – u'') and one solenidion (ω'') on the tarsus, five setae (db , v' – v'' , l' – l'') and one solenidion (φ) on tibia I, four setae (v' – v'' , l' – l'') on the genua, and three setae (d , v' , bv'') on the femora. Larval setae show the basic pattern described by Lindquist (1985). On the protonymph, the setal counts are 12(2ω)–5(1ω)–4–3–0, with four setae (tc' – tc'' , $l1'$, $v1'$) and one solenidion ω' usually added on the tarsus. On the deutonymph, the setal counts from tarsus to trochanter are 16 (3ω)–9 (1ω)–4–9–1: there are nine setae on femur I, compared with the basic pattern described by Lindquist (1985), femur I lacks seta l'' but seta $bv1'$ is present.

On adults of *B. pritchardi*, the number of setae from tarsus to trochanter are 20 (7ω)–15(1ω)–8–16–1. The additions on the tarsus are much richer than in the Tetranychinae: five setae $l'2$ – $l''2$, $v'3$ – $v''3$, $v'4$ and four solenidia $\omega'2$ – $\omega''2$, $\omega'3$ – $\omega''3$ are added on tarsus I. Compared to the species examined by Lindquist (1985), setae $v'4$ – $v''4$ are absent on tibia I. On the femora, the complement of setae on adult female is more variable, with setae l'' , $l''1$, $v'1$, $l''2$ suppressed on *B. pritchardi*.

Leg II: The setae basically show the basic pattern as described by Lindquist (1985) from larva to deutonymph, but there are variable changes in adult females of *B. pritchardi* (Tables 2, 3).

On the larva, the number of setae for *B. pritchardi*, from tarsus to trochanter are 8 (1ω)–5–4–3–0; setae tc' – tc'' are added to the tarsus on the protonymph; on the deutonymph, $v'1$ – $v''1$

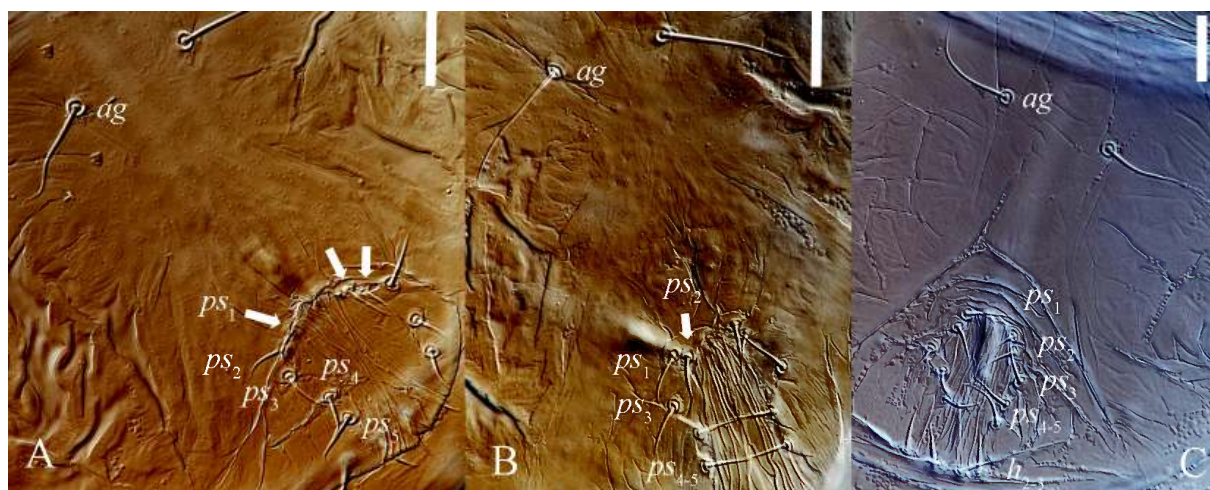


Figure 27 *Bryobia pritchardi*, photographs. Male: A–C, opisthosomal venters showing setation of genital areas of different specimens. Scale bars A–C, 10 μ m.

are added on the tarsus, while three setae ($l'-l''$, v'') are suppressed on femur compared with Lindquist (1985). The setal counts in females of *B. pritchardi* are 18 (1ω)–9–5–10–1. The basic pattern described by Lindquist is 16 (1ω)–9–6–10–1. Compared to Lindquist (1985), setae $v'3-v''3$ are present on the tarsus, seta $l'1$ are lacking on the genu, and setae v'' , $l'-l''$ are added on femur for the adult female of *B. pritchardi*.

Leg III: The setae from larva to protonymph in two species basically show the basic pattern as described by Lindquist (1985): 6–5–2–2–0 (in larva), 8–5–2–2–0 (in protonymph). On the deutonymph, 10–5–2–2–1 is the setae counts in *B. pritchardi*: the tarsus without solenidia (ω'' is suppressed); and setae d , v' , respectively, are absent on the genu and femur. As with adult females, setae $v''3$ and v' respectively are added on the tarsus and femur.

Leg IV: The complement of setae of two species from larva to deutonymph is less variable. The number of protonymphal setae in this species from tarsus to trochanters are 6–5–2–2–0, showing the basic pattern, as does the deutonymph (10–5–2–2–1), except that setae d suppressed on the genua. On adult females, setae l'' (instead of v'') are present on the genua, and l' (instead of v'') are present on femora.

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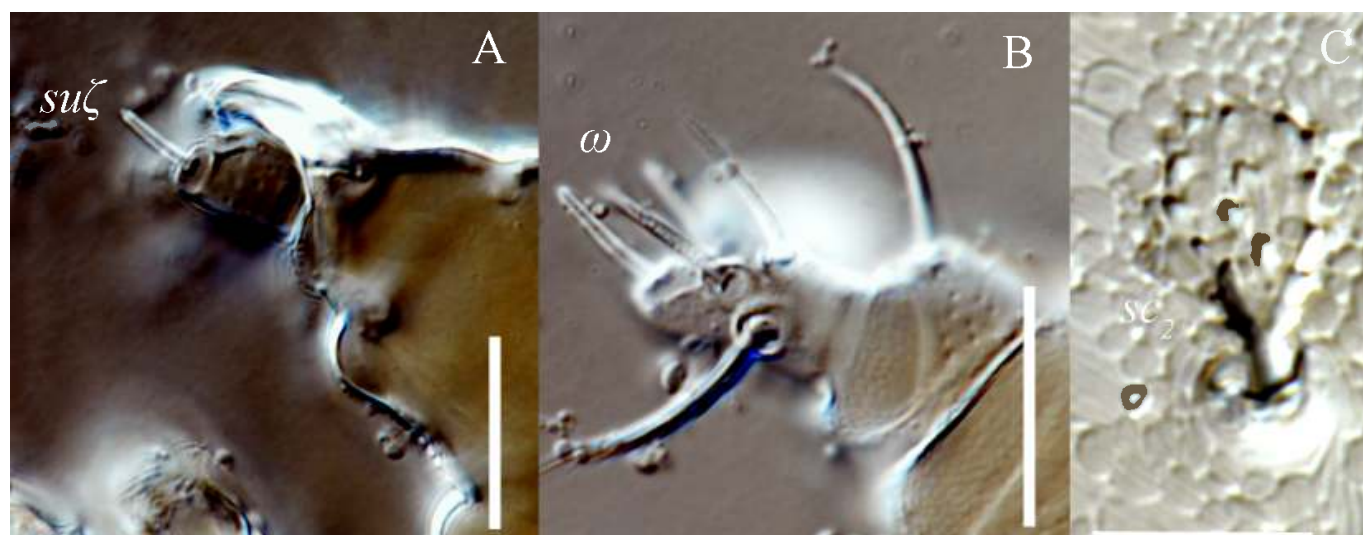


Figure 28 *Bryobia pritchardi*, photographs. Female: A, palp ventral view; B, palp dorsal view; C, the dorsal *sc*₂ setae. Scale bars A–C, 10 μ m.

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